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ABSTRACT

This report investigates five areas of university management and institutional research at the University of Calgary. These areas include: parameters for decisionmaking, academic program costs, space and facilities, information systems, and modeling. Statistical data are presented to substantiate the observations. (MJM)

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REPORT NO. 84

COMPANION TO THE UNIVERSITY OF CALGARY RESPONSE TO THE REPORT OF THE COMMISSION ON EDUCATIONAL PLANNING

OCTOBER, 1972

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OFFICE OF INSTITUTIONAL RESEARCH

Project 1118
October 12, 1972

The Cabinet Committee on Education
Suite 400, 11010 - 142 Street
Edmonton, Alberta T5N 2R1

Gentlemen:

This document was prepared on the suggestion of President A.W.R.Carrothers to serve as a companion to The University of Calgary submission to the Cabinet Committee on Education. Our Response comments on *A Choice of Futures* by illustrating our institutional research into those university management and related topics raised in the Commission Report.

We have been impressed by the subtle complexity of universities and the remarkable capacity that Canadian universities have shown over the past three decades in meeting society's needs. Yet, the flexibility of these institutions is limited. Sensible ways and means of promoting the government's social policy which nonetheless ensure survival of the traditional values and vitality of the universities must be found. This University has some experience in the management of change, and I hope this reservoir of expertise will be used to assist Alberta's social architects in the years that lie ahead.

We would like to express our appreciation for the continuing support and encouragement that the Office of Institutional Research has had from President Carrothers. He foresaw the need for management information to support a reasonable and credible accounting at all levels in the post-secondary educational sector before governments began to reflect and shape public desire for accountability.

Respectfully submitted,

Bernard S. Sheehan

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Director

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RESPONSE TO THE REPORT OF

THE COMMISSION ON EDUCATIONAL PLANNING

Bernard S. Sheehan

Office of Institutional Research
The University of Calgary

October 1972

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PRESIDENT'S FOREWORD

The Report of the Commission on Educational Planning emphasizes on several occasions that public resources devoted to education ought to be used as effectively as possible. This is a point of view with which we are happy to associate ourselves. We reject any blanket charge that universities have been wasteful of public resources in the past; but we also are fully aware that contemporary developments in management science are continually providing new ways of allocating and using resources more effectively. The University of Calgary acknowledges its obligation, similar to that of all public institutions, to make use of the most advanced management methods in pursuit of its proper goals of teaching, research, and service (or, as stated in the Report, discovery, criticism, career, and integration). An important mechanism for adopting modern management practices to our own needs is the Office of Institutional Research. Because the important work of the OIR is not widely known, we felt it advisable to include a description as a Companion to our Response. The Companion demonstrates the seriousness of this University's determination to use public funds in an accountable way. The Companion also demonstrates that certain regrettable allegations in the Report of the Commission on Educational Planning are without factual basis (specifically the declaration that university estimates of faculty workload and space requirements are artificially inflated, p. 128). By having an Office of Institutional Research, the University is able to separate its genuine needs for improvement from spurious criticisms resting on misinterpretation.

INTRODUCTION

As the Commission on Educational Planning was beginning its work in late 1969, The University of Calgary was implementing the recommendations in President Carrothers' Administrative Review.[1] An integral part of the new policy formulation and planning structure was the Office of Institutional Research.[2] The terms of reference of the OIR are:

> The primary function of the Office of Institutional Research is to provide statistical data, information, reports and analyses to the President and the University policy committees on request. The Office will provide similar services to other University individuals and groups as its information retrieval and analytical capabilities permit without hindering its primary role. As an applied research group and supportive of its purposes, the Office of Institutional Research on the request of the President *will develop modern management tools and techniques* which have University administrative application.

We now have nearly three years' experience in providing information and analytical support to University planners and decision-makers. Therefore, we welcome the Commission's strong endorsement of the adaptation of modern management tools and analytical techniques to university management and have used this common understanding as the basis for commentary on topics treated in the REPORT.[3]

Since we approach the REPORT as institutional researchers, it is

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[1]The University of Calgary, "Report of the President: Review of Administrative Structures and Functions," September 1969.

[2]President Carrothers set out the terms of reference of the Office of Institutional Research on November 10, 1969.

[3]"REPORT" is our convention for: Commission on Educational Planning, Report of the Commission, A Choice of Futures (Edmonton: Queen's Printer, 1972).

important that we identify ourselves as clearly as possible. Institutional Research has eluded the attempts of many authors to define it to the satisfaction of all. John Dale Russell takes the administrative point of view that institutional research includes "studies needed for the making of important decisions about policy and procedures."[1] Nevitt Sanford places greater emphasis on research and sees institutional research as "theoretically-oriented, long-term studies of students and intensive, probably also long term, studies of the inner workings of educational institutions."[2] Rourke and Brooks[3] contend that

> . . . institutional research is a variegated form of organizational self-study designed to help colleges and universities gather an expanding range of information about their own internal operations and the effectiveness with which they are using their resources.

Although institutional research, in some form, is not new to universities,[4] it is our view that no definition yet has gained a consensus because institutional research is not a single area of study nor a specific set of tools and techniques. Rather, it is better characterized by its practitioners' approaches to problem solving. Thus, our thesis, which generalizes from

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[1]John Dale Russell, "Dollars and Cents: Some Hard Facts," in Higher Education: Some Newer Developments, ed. by Samuel Bashin (New York: McGraw-Hill, 1965), pp. 284-303.

[2]Nevitt Sanford, ed., The American College (New York: John Wiley, 1962), pp. 1027-1028.

[3]Francis E. Rourke and Glenn E. Brooks, Managerial Revolution in Higher Education (Baltimore: Johns Hopkins Press, 1966), p. 44.

[4]W. H. Cowley, "Two and a Half Centuries of Institutional Research," in College Self Study: Lectures on Institutional Research, ed. by Richard G. Axt and Hall T. Sprague (Boulder, Colorado: The Western Interstate Commission for Higher Education, 1960), pp. 1-16.

those above, is that institutional research in the universities is the application of systems science to governance problems[1] and this is the approach we have taken in commenting on the REPORT.

The REPORT's table of contents says, "Tomorrow's educational services cannot be dealt with in conventional terms. Hence this report, like many of the activities leading up to it, is different." Thus, it seems that the latitude of the Commission's mandate has led to an unconventional presentation which hinders systematic analysis and comment on issues and recommendations. Nonetheless, many of the aspects of university management and institutional research which are treated in the REPORT fall into the following five categories. In order to facilitate comment on these topics, our submission is divided into these sections:

1) Parameters for Decision Making
2) Academic Program Costs
3) Space and Facilities
4) Information Systems
5) Modeling

A document the size of this submission cannot treat in detail each of the numerous topics in university management and institutional research discussed or implied in the REPORT. Therefore, we have made appropriate reference to various OIR reports and other documents which give specific facts or further develop themes introduced in this submission.

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[1] Bernard S. Sheehan, "Institutional Research As Adjunct to University Management," STOA (Fall 1972), in press.

SECTION I

PARAMETERS FOR DECISION-MAKING

Enrolment Projections

Despite the recent decline in enrolment, the REPORT suggests that enrolment in higher education will grow (83).[1] This assertion agrees with those cited in the Wright Commission Draft Report[2] and recent data provided by the National Center for Educational Statistics in Washington.[3] In our opinion, though the sharp thrusts of the '60's are over, enrolment at The University of Calgary will climb in the '70's.

The Office of Institutional Research has been involved in a process of periodic review of enrolment projection methodologies for three years. Our current methods are a combination of well-known projection techniques, i.e., regression analysis, ratio analysis, cohort-survival rate analysis and student flow simulation using Markov chain models. By using a combination of various techniques, we have tried to minimize shortcomings of individual methods[4] and at the same time provide the opportunity for input

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[1] As topics in this submission are associated with the text of A Choice of Futures, a link is provided to ideas in the REPORT by the insertion of bracketed REPORT page numbers throughout this text.

[2] Commission on Post-Secondary Education in Ontario, Draft Report (Toronto: Queen's Printer, 1972), p. 99.

[3] "Higher Education, 1980: New Federal Projections," The Chronicle of Higher Education, April 17, 1972, p. 1.

[4] I. B. Turksen, "A Micro Level Forecasting Model of Student Enrollment" (paper presented at the 37th ORSA Conference, Washington, 1970);

of policy decisions and subjective judgment. Our long-term objective is to build an interactive student flow model[1] which will provide input for the kind of models described in Section V.

Ratio analysis is used to tie university enrolment (83) to demographic data and high school graduate statistics (55). Regression analysis is used to evaluate trends of ratios and actual enrolments. The survival rate method as currently used is a first order Markov model yielding enrolment distribution projections by student academic programs and year. An input of policy decisions or input based on the analysis of historical trends is possible by the choice of first year student distribution into various academic programs and the choice of survival rates from year to year in each program. Figures 1, 2 and 3 give representative data used in the application of these projection methods. Figure 1 illustrates demographic and enrolment data and deduced participation rates for Alberta, Canada and representative States for the period 1965/66 to 1977/78 (83). Figure 2 gives data useful in estimating future first year enrolments at the university. Figure 3 shows the distribution and survival rate data used in the Markov model techniques.

In-depth studies to evaluate student enrolment projection methods

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Wayne Smith, "A Student Flow Model" (Los Angeles: Office of Advanced Planning, UCLA, 1970); J. F. Zimmer, "Projecting Enrolment in a State College System," Institutional Research and Institutional Policy, ed. by Clifford Stewart (Claremont, California: The Association for Institutional Research, 1971); J. Benard, "General Optimization Model for the Economy and Education," Mathematical Models in Educational Planning (Paris: Organisation for Economic Co-operation and Development, 1967).

[1] Letter from Bernard S. Sheehan to President A. W. R. Carrothers, The University of Calgary, December 3, 1971.

Figure 1

DEMOGRAPHIC DATA AND PARTICIPATION RATES

YEAR	ALBERTA POPULATION AGE 18-24[a]	FULL-TIME ENROLMENT IN ALBERTA UNIVERSITIES[b]	ALBERTA PARTICIPATION RATE AS PERCENT OF AGE 18-24[c]	CANADIAN PARTICIPATION RATE AS PERCENT OF AGE 18-24[d]	UNITED STATES PARTICIPATION RATE AS PERCENT OF AGE 18-24[e]
1965/66	147652	14749	10.0	10.1	19.4
1966/67	153003	16858	11.0	10.6	20.1
1967/68	158000	19688	12.5	11.4	20.8
1968/69	167800	24922	14.9	11.9	21.5
1969/70	178550	28443	15.9	11.7	21.1
1970/71	189300	30991	16.4	11.5	21.0
1971/72	196891	31400	16.0	14.4 Projected	21.5
PROJECTED					
1972/73	204369	37195	18.2	15.5	21.8
1973/74	213023	41113	19.3	16.4	22.4
1974/75	223214	45536	20.4	17.4	23.0
1975/76	231169	49701	21.5	18.3	24.0
1976/77	238723	53951	22.6	19.2	24.0
1977/78	248945	59000	23.7	19.9	24.0

[a]Alberta population figures up to 1970/71 from Alberta Bureau of Statistics, projected figures to 1975/76 from Zsigmond and Wenaas, Enrolment in Educational Institutions by Province, 1951/52 to 1980/81 (E.C.C. Staff Study No. 25).

[b]Junior Colleges' University level enrolment included.

[c]Projections are a result of extrapolated linear regression of actual participation rates.

[d]Actual numbers from DBS 81-204 Survey of higher education. Projections from E.C.C. Staff Study No. 25.

[e]Projection of Educational Statistics to 1977/78 (1968 Edition) U. S. Department of Health, Education and Welfare, Office of Education, Washington, D. C.

Figure 2

STATISTICS TO SUPPORT FIRST-YEAR ENROLMENT PROJECTIONS

YEAR	18 YEAR OLD POPULATION IN ALBERTA[a]	1 YEAR ENROLMENT IN ALBERTA UNIVERSITIES[b]	ALBERTA MATRICULANTS	ALBERTA GRADE 12 STUDENTS	RATIO: ALBERTA GRADE 12 / 18 YEAR OLDS	RATIO: ALBERTA UNIVERSITIES 1ST YEAR / MATRICULANTS 1 YEAR PREVIOUS	RATIO: ALBERTA UNIVERSITIES 1ST YEAR / GRADE 12 1 YEAR EARLIER
1965/66	24585	4959	5392	21781	.8859	1.08	.25
1966/67	26289	6274	6886	21970	.8357	1.16	.29
1967/68	27913	7137	7819	22484	.8055	1.04	.32
1968/69	29438	8598	7910	25227	.8570	1.10	.38
1969/70	30762	9194	7787	27138	.8822	1.16	.36
1970/71	31949	9459	7959	28963	.9065	1.21	.35
1971/72	33087	9740 Prel.		31033[c]	.9379	1.22	.34
1972/73	34236			33629	.9823		
1973/74	35392			34005	.9608		
1974/75	36779			35425	.9632		
1975/76	37392			36230	.9689		
1976/77	38175			36839 (OIR)	.9650		

[a]Projections by Alberta Oil and Gas Conservation Board.

[b]Including Junior Colleges.

[c]Projections by the Alberta Department of Education and Office of Institutional Research 1976/77.

Figure 3

UNIVERSITY OF CALGARY — FIRST YEAR STUDENT ENROLMENT — OFFICE OF INSTITUTIONAL RESEARCH

NUMBER OF STUDENTS BY FACULTY — MARCH 1972 — PAGE 04

OBSERVATION	ARTS + SCIENCE	BUSINESS	EDUCATION	ENGINEERING	FINE ARTS	MEDICINE	NURSING	PHYSICAL EDUCATION	SOCIAL WELFARE	UNIVERSITY TOTAL
1962	336	73	309	94	4	0	0	4	0	820
1963	392	76	283	111	13	0	0	21	0	896
1964	483	76	265	158	5	0	0	22	0	1009
1965	600	93	302	186	12	0	0	33	0	1226
1966	692	124	371	207	22	0	0	53	0	1469
1967	855	148	399	232	32	0	0	91	0	1757
1968	1175	198	541	252	65	0	0	125	0	2356
1969	1197	175	508	280	103	0	0	113	0	2376
1970	1394	243	453	247	130	0	52	108	0	2627
1971	1350	242	359	199	111	0	31	106	65	2463
VARIABLE NUMBER	1	2	3	4	5	6	7	8	9	10

PERCENTAGE OF STUDENTS BY FACULTY

OBSERVATION	ARTS + SCIENCE	BUSINESS	EDUCATION	ENGINEERING	FINE ARTS	MEDICINE	NURSING	PHYSICAL EDUCATION	SOCIAL WELFARE	TIME
1962	40.976	8.902	37.683	11.463	.488	0.000	0.000	.488	0.000	1
1963	43.750	8.482	31.585	12.388	1.451	0.000	0.000	2.344	0.000	2
1964	47.869	7.532	26.264	15.659	.496	0.000	0.000	2.180	0.000	3
1965	48.940	7.586	24.633	15.171	.979	0.000	0.000	2.692	0.000	4
1966	47.107	8.441	25.255	14.091	1.498	0.000	0.000	3.608	0.000	5
1967	48.662	8.423	22.709	13.206	1.821	0.000	0.000	5.179	0.000	6
1968	49.873	8.404	22.963	10.696	2.759	0.000	0.000	5.306	0.000	7
1969	50.379	7.365	21.380	11.785	4.335	0.000	0.000	4.756	0.000	8
1970	53.064	9.250	17.244	9.402	4.949	0.000	1.979	4.111	0.000	9
1971	54.811	9.825	14.576	8.080	4.507	0.000	1.299	4.304	2.639	10
VARIABLE NUMBER	11	12	13	14	15	16	17	18	19	20

FACULTY SURVIVAL RATES — MARCH 1972 — PAGE 12

UNIVERSITY OF CALGARY — OFFICE OF INSTITUTIONAL RESEARCH

UNDERGRADUATE STUDENT ENROLMENT: FACULTY OF ARTS & SCIENCE

OBSERVATION	FIRST YEAR	SECOND YEAR	THIRD YEAR	FOURTH YEAR	OTHER	TOTAL	TIME
1962	336	205	105	0	10	656	1
1963	392	219	171	7	6	795	2
1964	483	348	202	26	28	1087	3
1965	600	447	298	24	26	1395	4
1966	692	547	405	29	24	1697	5
1967	855	630	484	40	60	2049	6
1968	1175	895	655	36	60	2821	7
1969	1197	1142	939	48	66	3392	8
1970	1394	1254	1135	131	63	3977	9
1971	1350	1167	1118	191	89	3915	10
VARIABLE NUMBER	1	2	3	4	5	6	7

SURVIVAL RATES(SR): FACULTY OF ARTS & SCIENCE

OBSERVATION	SR 1-2	SR 2-3	SR 3-4	OTHER/TOTAL	AVERAGE SR 1-2	AVERAGE SR 2-3	AVERAGE SR 3-4
1962	0.000	0.000	0.000	.015	0.000	0.000	0.000
1963	.652	.834	.067	.008	.652	.834	.067
1964	.888	.922	.152	.026	.770	.878	.109
1965	.925	.856	.119	.019	.822	.871	.113
1966	.912	.906	.097	.014	.844	.880	.109
1967	.910	.848	.099	.029	.857	.873	.107
1968	1.047	1.040	.078	.021	.889	.901	.102
1969	.972	1.049	.073	.019	.901	.922	.098
1970	1.048	.994	.140	.016	.919	.931	.103
1971	.837	.892	.168	.023	.910	.927	.110
VARIABLE NUMBER	8	9	10	11	12	13	14

OIR 84
10/72

used at present and to propose an improved methodology to refine and extend present techniques should be given increased priority (219, 114). The techniques used at present do not explicitly incorporate factors which are mainly brought about by exogenous circumstances such as the rate of unemployment, or the change in length of time between high school graduation and entry into university (7, 38, 82-84). If any of these factors becomes predominant, projections based on past trends will not be accurate (227). Prior to any proposed study of enrolment projections, an analysis of availability[1] and cost of data for a multicorrelation matrix of independent variables affecting student enrolment should be conducted. Variables which should be investigated and tested for statistical independence may include: economic variables such as gross national product, percent unemployment, research expenditures, personal income spent on education, oil industry revenues; and, opportunity cost parameters such as earnings in various occupational fields, rate of success in obtaining employment in various fields related to field and level of education, manpower planning (220).

Other cultural and psychological factors, such as changes in "values underlying the structure of society" or "values governing the conduct of activity" (32) cannot be measured quantitatively; however, insights can be applied to reflect general observations based on press, literature and other media. Analysis of these parameters represents a different type of challenge from the traditionally utilized demographic data, student flow parameters and factors of governmental and institutional

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[1] C. C. Lovell, Student Flow Models: A Review and Conceptualization [Preliminary Edition], Technical Report 25 (Boulder, Colorado: National Center for Higher Education Management Systems at WICHE, 1971).

policies related to enrolment limitations, admission standards and new program introductions. If changes in such cultural and psychological factors gain predominant influence on enrolment patterns, prediction of future enrolment becomes virtually impossible. Still, research into forecasting student flow patterns throughout institutions of higher education should follow or complement determination of what information is needed for what purposes by decision makers, in institutions and government at all levels (229-230). For example, the resources required to provide services to a given number and distribution of students is important management information. A simulation model as discussed in Section V uses student enrolments growing in size to 16,500 full-time students to estimate the resource requirements necessary to service those student populations (85, 219).

Fact Book

While fulfilling its function of providing statistical data to the President and the University policy committees, the Office of Institutional Research has established an extensive data bank of statistical indicators useful for planning and decision-making at all levels of university management (83, 219).

The Fact Book[1] is issued annually and lists historical and current statistical information from this data bank. It contains enrolment data; various parameters for measuring teaching load and student success (course related statistics); faculty and staff, finance and space data. Enrolment

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[1]Office of Institutional Research, Reports 13, 55, 77 (Calgary: The University of Calgary).

information contains national, provincial and University of Calgary data by student program parameters such as faculty, degree, level and other student characteristics such as sex, home address and citizenship. Course data shows weekly student hours, enrolees, section hours, average section sizes, course counts (212), mark distributions and grade point distributions. Staff data includes full and part-time academic and support staff and full-time equivalents of part-time staff. The finance section shows enrolment units by faculty, i.e., weights for formula financing (292), revenues, operating and capital expenditures and trust funds for research. The space section shows space inventory by building and function.

Mark Analysis

Analyses of the distribution of grades received by students at The University of Calgary have been prepared[1] for the years 1968/69 to 1970/71 (204-213). They give details of marks and grade point averages for students by faculty, program, level, sex, and for courses by faculty, teaching department and level. In addition, an analysis of grades of transferring college students from Red Deer College, Medicine Hat College, and Mount Royal College to The University of Calgary was performed[2] (141, 142).

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[1]Office of Institutional Research, Distribution of Grades to 1970/71, Report 63 (Calgary: The University of Calgary, 1972).

[2]Office of Institutional Research, Comparison of Grades: College Transfer Students vs. Total University 1968-1971, Report 76 (Calgary: The University of Calgary, 1972), shows junior college transfer data: grade point averages, withdrawals and comparative student achievement in various academic disciplines.

Students transferring to The University of Calgary after obtaining one year's accreditation in Alberta's community colleges do not achieve academically as well as the University's total student population. Average grade points achieved in all courses by undergraduate students for the three academic years 1968 to 1971 were:

Academic Year	The University of Calgary Total (Including First-Year Students)	College Transfers
1970/71	2.45	2.24
1969/70	2.41	2.23
1968/69	2.38	2.16

These findings generally coincide with those of similar studies conducted in the United States and Canada.[1]

Lack of adequate knowledge in prerequisite courses, lower academic capabilities and different socioeconomic backgrounds are suggested in the literature as some of the possible reasons for the manifested lower achievement. Further studies are needed to determine the correlation of various student characteristics to transfer students' achievement in Alberta. Discussions with Mount Royal College have been initiated to identify barriers to transferability in hope of determining ways to minimize these difficulties (139-143).

Economic Impact

In recent years, the universities have been called upon to provide

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[1] See Bibliography (p. 20) of Office of Institutional Research Report 76.

proof that their demands for a larger share of provincial resources are justified. It is a difficult task because cost-finding methodologies are not well developed[1] and the output or benefit of the educational enterprise is elusive to define, to quantify, and to measure. However, universities are attempting to evolve the necessary management tools and techniques[2] which will assist administrators to allocate university resources more effectively and at the same time provide credible accounting to the university's constituency (107, 219, 221, 273).

As in the case of other institutions,[3] the impact of The University of Calgary on Calgary's economy accrues in more ways than those of improved knowledge and higher lifetime income of its citizens, research and other benefits for its business, industry and people (228). Benefits accrue in the form of additional employment and income for local residents, because of the multiple effect of a business volume generated by university-related spending which is greater than the initial government investment in the university: Figure 4. The methodology of an Office of Institutional Research

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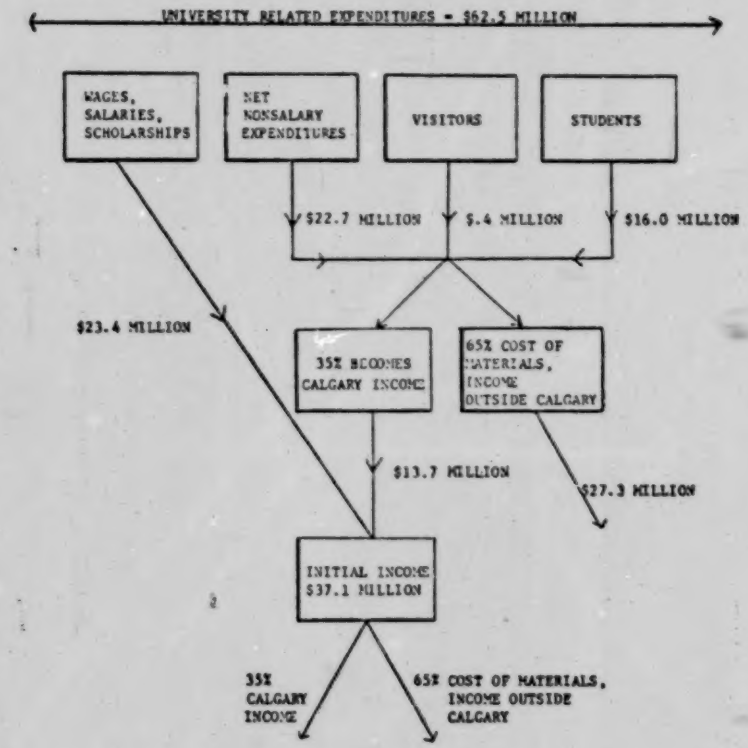
[1]Office of Institutional Research, A Preliminary Evaluation of Cost Studies in Higher Education (Berkeley: University of California, October, 1969).

[2]For example see the series of publications by the National Center for Higher Education Management Systems at Western Interstate Commission on Higher Education, Boulder, Colorado.

[3]"State Economy Benefited by $383 Million from University Operations in 1969-70," based on: Robert D. Lamson, Elements Relating to the Impact of the University of Washington upon the State and King County, (Seattle: University of Washington, 1971); Ira Stephen Fink, "The Community Impact of The University of California's Berkeley and Santa Cruz Campuses" (Berkeley: University of California, Office of the Vice President, April 1967); Ronald Merchant, "The Economic Impact of Spokane Community College on the Spokane Metropolitan Area" (unpublished Masters Thesis, Gonzaga University, 1969).

Figure 4

MONEY AND INCOME FLOWS
GENERATED BY THE UNIVERSITY OF CALGARY RELATED 1971/72 SPENDING



Initial income of $37.1 million times the 1.9 initial income multiplier equals $70.3 million total local income.

Figure 5

DISTRIBUTION OF LOCAL 1971/72 EARNINGS
GENERATED BY THE UNIVERSITY OF CALGARY RELATED EXPENDITURE

TOTAL INCOME = $70.3 MILLION
HOUSING AND UTILITIES $9.7 MILLION
FOOD AND BEVERAGES $12.1 MILLION
FURNISHINGS $3.7 MILLION
CLOTHING $6.9 MILLION
HOUSEHOLD OPERATION $2.8 MILLION
TOBACCO AND ALCOHOL $2.5 MILLION
CAR PURCHASE AND OPERATION $7.2 MILLION
OTHER $10.2 MILLION
PERSONAL TAXES $8.8 MILLION
RECREATION $3.1 MILLION
SECURITY $3.3 MILLION

Source: Based on patterns of spending by urban families. See: Dominion Bureau of Statistics Catalogue #62-530, Urban Family Expenditure 1967, March, 1971, p. 31 (Edmonton Pattern).

study[1] arrived at an initial--final income multiplier of $1.90:$1.00. The University of Calgary in 1971/72 supported an estimated 7,800 local jobs, close to 5 percent of all jobs in Calgary and approximately $70 million of earnings for local residents. This impact was the multiplied effect of a $62 million volume of business activity generated by the University in return for direct government investments totalling $45 million in the same year. Some $39 million of these earnings will be spent in retail stores, $12.1 million of which will flow into the food and beverage industry, $6.9 million into the retail clothing industry, and $7.2 into the retail automobile and car maintenance and operation industries as shown in Figure 5.[2]

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[1]Office of Institutional Research, The Economic Impact of The University of Calgary on the City of Calgary, Report 64 (Calgary: The University of Calgary, 1971).

[2]Office of Institutional Research, Report 64.

SECTION II

ACADEMIC PROGRAM COSTS

The University of Calgary Cost Study

Formula financing has been used for distributing provincial government operating contributions to Alberta universities since 1967/68 (292). The current formula financing approach distributes operating monies to universities based upon each university's student enrolments weighted to reflect salient differences in each student's program of studies. In 1970 the Universities Commission commenced an investigation to determine whether the student weights at present used in the distribution formula fairly reflect the costs of the various student programs, and invited The University of Alberta and The University of Calgary to participate in the analysis by undertaking comparative cost studies (292). These studies determined the institutions' operating costs in terms of students' academic programs[1] (107).

The determination of the reliability of the results using

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[1]The results of the study performed at The University of Alberta are published in A Study of the Costs of University Programs: The University of Alberta Cost Study 1969/70 (Edmonton, Alberta: Office of Institutional Research and Planning, The University of Alberta, 1971) and A Study of the Costs of University Programs: The University of Alberta Cost Study 1970/71 (Edmonton, Alberta: Office of Institutional Research and Planning, The University of Alberta, 1972). The results of The University of Calgary study are published in The University of Calgary Cost Study 1969/70, Report 61 (Calgary, Alberta: Office of Institutional Research, The University of Calgary, 1971) and The University of Calgary Cost Study 1970/71, Report 74 (Calgary, Alberta: Office of Institutional Research, The University of Calgary, 1972).

the given methodology was considered by The University of Calgary as a second objective of the study. The Office of Institutional Research has performed selected sensitivity tests to determine the influence of certain critical assumptions in the methodology.[1] Several alternative methodologies have also been examined.[2] The third objective of the cost study was to serve as a learning opportunity in a continuing exploratory program on management aids and techniques such as planning, programming, budgeting systems (222); resource requirements prediction and cost simulation models; and fee-for-service arrangements which have promise of application to university administration.

The methodology of The University of Calgary Cost Study is based on three principles:

a) Institutional outputs are the result of institutional activities.
b) Output contributing activities are sustained by resource allocations.
c) The cost of organizational outputs can be measured as the sum of the cost of the resource contributions of the activities producing the output.

Each of these principles translates into a separate component of the study described briefly as follows:

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[1] Bernard S. Sheehan and Mervin G. Michaels, "Sensitivity Tests on a University Cost Study Methodology," Institutional Research and Institutional Policy Formulation: Proceedings of the Eleventh Annual Forum, ed. by Clifford T. Stewart (Claremont, California: The Association for Institutional Research, 1971), pp. 186-190.

[2] Ivor Wm. Thompson and Philip A. Lapp, A Method for Developing Unit Costs in Educational Programs, Council of Ontario Universities CPUO Report No. 70-3 (Toronto, 1970); K. M. Hussain, A Resource Requirements Prediction Model (RRPM-1) -- Guide for the Project Manager, Technical Report 20 (Boulder, Colorado: National Center for Higher Education Management Systems at Western Interstate Commission for Higher Education, October, 1971).

Phase I: University Activity Analysis

A set of university activities is defined and estimates are made of the extent to which each organizational unit contributes to each activity.

Phase II: Activity Cost Synthesis

The costs of the activities of the university are determined by relating the resource allocations of each organizational unit to the activities undertaken by each of them.

Phase III: Cost Per Student Synthesis

The costs of the university activities are translated into costs per student academic program and summed to yield institutional cost per student.

Figure 1 shows sample results of the cost study, giving the relative costs of academic programs for both years of the study, and compares these relative costs with the current province of Alberta student weights (enrolment unit weights). Office of Institutional Research Report 74 also gives detailed information on the costs associated with various activities such as instruction, research, library services, department administration, faculty administration, and university-wide costs for both full and part-time students in each of several hundred student academic programs. Figure 2 illustrates the detail available in that document.

In interpreting the detailed cost data one should bear in mind the purpose of the study. According to the National Association of Accountants:

> Only by clearly describing and relating the various purposes for which costs are to be used is it possible to determine the types of cost data needed for each purpose and the principles and techniques which should govern their development. Costs are used

Figure 1

THE UNIVERSITY OF CALGARY COST STUDY
SAMPLE RESULTS: RELATIVE COST PER STUDENT ACADEMIC PROGRAM
1969/70 AND 1970/71[1]

CURRENT ENROLMENT UNIT WEIGHTS	UNDERGRADUATE PROGRAMS	YEAR 1		YEAR 2		YEAR 3		YEAR 4	
		69/70	70/71	69/70	70/71	69/70	70/71	69/70	70/71
1	General Arts & Science	-	1.0	-	-	-	-	-	-
	Pass Arts	1.0	0.9	1.0	0.9	1.3	1.1	-	1.5
	Pass Science	1.2	1.3	1.3	1.3	1.5	1.6	-	1.5
	1st Year Honors Arts	1.1	-	-	-	-	-	-	-
	1st Year Honors Science	1.3	-	-	-	-	-	-	-
	1st & 2nd Year Nursing	-	2.1	-	-	-	-	-	-
1.5	Fine Arts	1.5	1.4	1.9	1.5	2.7	1.9	4.2	2.6
	Business	1.0	0.8	1.0	0.7	0.9	0.8	1.3	0.8
	Physical Education	1.6	1.3	1.7	1.3	1.8	1.4	-	2.6
	1st & 2nd Year Education	1.1	1.1	1.2	1.0	-	-	-	-
	1st & 2nd Year Engineering	1.8	2.0	2.1	2.0	-	-	-	-
	2nd, 3rd & 4th Year Honors Arts	-	-	1.2	1.2	2.4	2.0	2.5	2.6
2	Music	2.2	1.6	3.9	2.0	4.3	2.6	3.8	3.9
	2nd, 3rd & 4th Year Honors Science	-	-	1.7	1.8	2.3	2.3	3.2	3.3
	3rd & 4th Year Education	-	-	-	-	1.3	1.0	1.4	1.2
3	3rd & 4th Year Engineering	-	-	-	-	2.8	2.3	4.1	3.1

CURRENT ENROLMENT UNIT WEIGHTS	GRADUATE PROGRAMS	MASTERS		LOWER DOCTORAL		UPPER DOCTORAL	
		69/70	70/71	69/70	70/71	69/70	70/71
2	Social Welfare	4.4	3.7	-	-	-	-
3	Arts	4.9	3.5	-	-	-	-
	Arts	-	-	4.6	3.4	-	-
	Education	4.0	3.4	-	-	-	-
	Education	-	-	4.4	4.2	-	-
4	Science	5.3	4.3	-	-	-	-
	Science	-	-	7.7	4.0	-	-
	Engineering	5.8	4.3	-	-	-	-
	Engineering	-	-	4.8	4.3	-	-
6	Arts	-	-	-	-	4.5	2.9
	Education	-	-	-	-	4.8	4.0
	Engineering	-	-	-	-	4.4	3.1
	Science	-	-	-	-	5.0	4.0

[1]The base used in The University of Calgary Cost Study 1969/70 is Pass Arts 1. That used in the 1970/71 study is a weighted average of Pass Arts 1 and General Arts & Science 1 due to a program change.

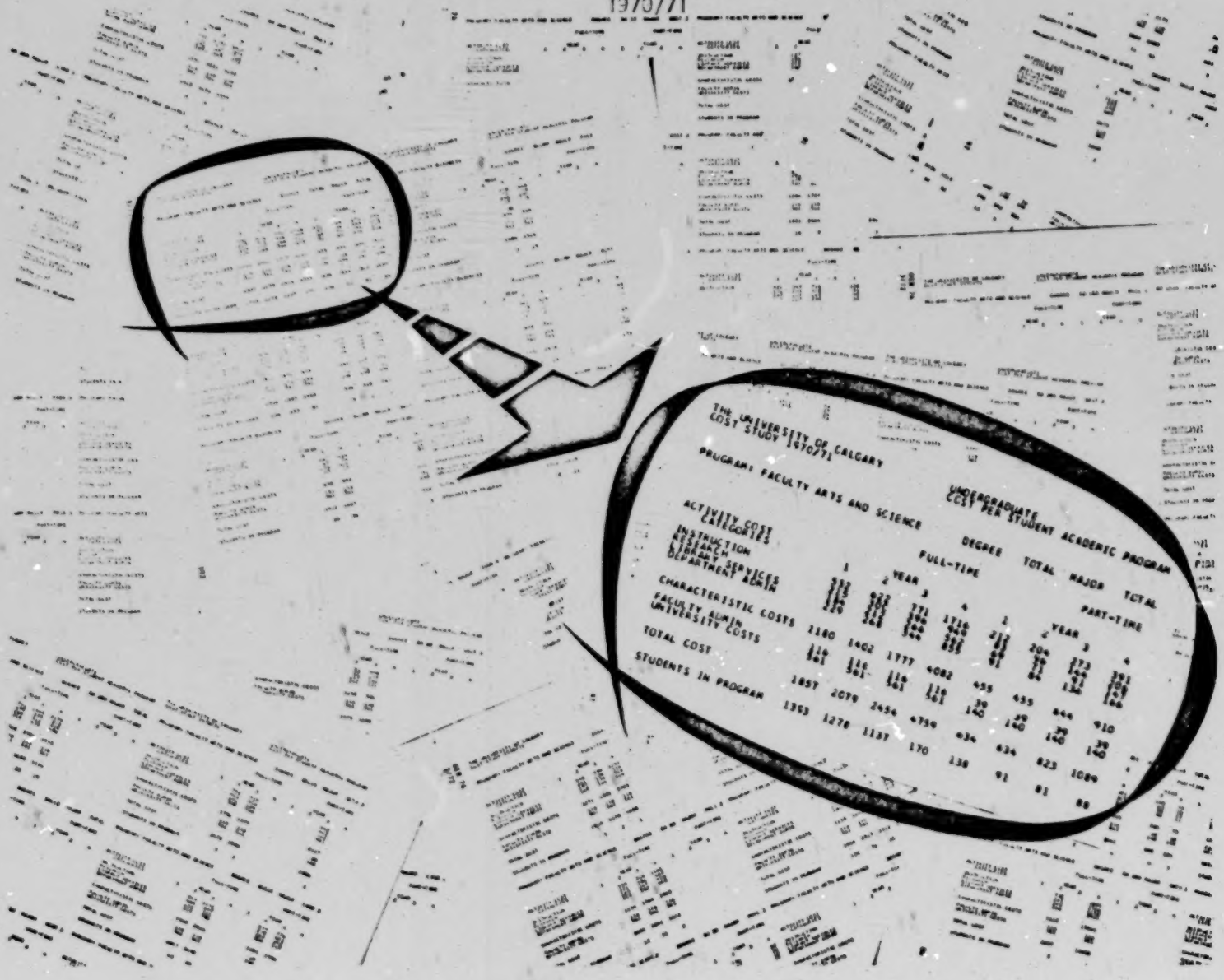
for a variety of purposes, and the same data cannot service all purposes equally.[1]

For example, the REPORT wrongly used the results of the cost study in

[1]National Association of Accountants, "The Uses and Classification of Costs," Studies in Cost Analysis, ed. by David Solomons (Homewood, Illinois: Richard D. Irwin, Inc., 1968), p. 106.

Figure 2

THE UNIVERSITY OF CALGARY COST STUDY
DETAILED COST PER STUDENT ACADEMIC PROGRAM
1970/71



stating that the cost of maintaining a student in Alberta universities is $3,385 (107). Universities are widely recognized as being institutions of research and public service (56). These latter functions are separate from instruction, and should not be considered in interinstitutional comparisons of the cost of the teaching function[1] (106). The cost study methodology allocated the costs of research and public service to student academic programs to satisfy the Universities Commission's purpose of evaluating current enrolment unit weights. The cost of instruction at the Alberta universities is considerably less than quoted in the REPORT.

Faculty Activity Analysis

Faculty represent a major institutional resource whose salaries account for 60 to 80 percent of most university operating budgets. Faculty are an indispensable element in the combination of resources and efforts devoted to attaining most instruction, research, and public service objectives. The importance of managing this resource has long been recognized.[2] With the increased emphasis on program budgeting and accounting, the faculty activity analysis survey, as a management tool, has assumed a major role (291). The Office of Institutional Research has developed a form for

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[1]Refer to G. B. Weathersby, "Development and Application of a University Cost Simulation Model," unpublished monograph (Berkeley: University of California, Office of Analytical Studies, June 1967); and Warren W. Gulko, Program Classification Structure, 1st edition (Boulder, Colorado: National Center for Higher Education Management Systems and Western Interstate Commission for Higher Education, 1971).

[2]F. W. Reeves and John Dale Russell, "Instructional Loads," College Organization and Administration (Indianapolis, Indiana: Board of Education, Disciples of Christ, 1929), pp. 165-182.

professors to report annually their activities to the President[1] (128). Among the data collected is an estimate of how faculty distribute their time in terms of a percentage. These survey results are used to cost the activities of departments for purposes of determining student academic program costs (107).

Because of the nature of professional activities and the difficulty with their quantification, the validity of most statistical studies of professional work load has been questioned (128). Professionals are given considerable latitude in selecting work patterns, combined with an implied ethic of individual responsibility and self-discipline, because it is under these conditions that their energies are thought to flow most productively. The validity of The University of Calgary faculty activity analysis data was assessed by comparisons with data from other institutions. The data were consistent with those collected by The University of Alberta. Comparisons with the University of Toronto[2] study, the University of Colorado[3] study and the University of California (Berkeley)[4] study also showed consistency. The results were further comparable to those obtained by the

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[1]Office of Institutional Research, Report 74, pp. 48-64.

[2]B. L. Hansen and S. Sandler, Report on a Study of Faculty Activities at the University of Toronto (Ontario: University of Toronto, Office of Institutional Research, 1967).

[3]Betty McMichael, Summary of Annual Faculty Reports 1967-68 (Boulder: University of Colorado, Office of Institutional Research, 1968).

[4]Preliminary results of "Faculty Effort and Output Study" conducted at the University of California, Berkeley, described in a memorandum to Members of the Committee on Educational Policy from the Office of the President, January 9, 1970.

Committee of Vice-Chancellors and Principals of the Universities of the United Kingdom, a study that was based not on faculty questionnaire responses but rather on periodic diaries maintained by a sample of professors.[1] A recent Canadian report on faculty profiles states:

> The best available statistical studies suggest that, on average through the year, the typical professor, like other professionals in occupations where the individual has substantial autonomy, works appreciably longer hours than most members of the labour force.[2]

While the acceptance of faculty activity analysis surveys, as a tool to assist in resource management, appears to be well recognized by its widespread use, much more research is required to refine activity definitions, to relate the benefits of faculty activities to institutional programs, and to obtain a profile of professional academic work patterns. In this regard, the National Center for Higher Education Management Systems at WICHE is undertaking one of the largest of the current efforts.[3] The Office of Institutional Research is developing software to test the sensitivity of the costs per student academic program to variations in the faculty time distributions.

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[1]The Committee of Vice-Chancellors and Principals of the Universities of the United Kingdom, Report of an Inquiry into the Use of Academic Staff Time (London, England: The Association of Commonwealth Universities, 1972).

[2]Bernard Trotter, David L. McQueen, and Bertram L. Hansen, "The 10 O-Clock Scholar?," What a Professor Does for His Pay (Toronto: Council of Ontario Universities, 1972), p. 2.

[3]L. C. Romney, "Faculty Activity Analysis Procedures Manual" [draft for review] (Boulder, Colorado: National Center for Higher Education Management Systems at Western Interstate Commission for Higher Education, January 1972).

SECTION III

SPACE AND FACILITIES

The University of Calgary recognized the importance of space management and planning and developed a space information system which permits effective planning, acquisition, allocation, and control of space. The system described in the following paragraphs was initiated in 1968. It consists of an accurate space inventory and an effective methodology for maintaining it, an objective space planning methodology which reflects "emerging trends and needs" (128), and automated techniques yielding space utilization information in convenient formats. The system developed by the Office of Institutional Research uses flexible software unique to this University which can satisfy the information needs of all levels of university management.

Space Inventory

The University of Calgary space information system (227) consists of: an inventory, a control/maintenance mechanism, and associated software for editing and updating the file and retrieval of data. It must satisfy many different user demands: planners to determine future space and facilities needs, administrators to make decisions on allocation and renovation of space, registrars to timetable it, even purchasing departments to locate customers' departments for delivery of articles. Only an advanced computer-assisted system will suffice (219).

Until 1967 when the inventory consisted of some 800,000 gross square feet, it was maintained manually.[1] Initial steps were then taken to

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[1] Office of Institutional Research, Space Inventory: Preliminary, Report 14 (Calgary: The University of Calgary, 1970).

automate the system and since that time a number of computerized inventories have been published.[1] Today, this automated system accounts for three million gross square feet and contains about a quarter of a million discrete items, structured in a way to produce formats useful to the management function (232). The software package associated with the space information system possesses sufficient flexibility to generate a wide range of space report formats quickly.

The Office of Institutional Research has developed procedures to carry out physical surveys which fall into four main categories:

a) Initial - a total survey where no former inventory existed.
b) Partial - a survey of newly constructed buildings.
c) Data element - a total survey of a specific data element.
d) Maintenance - a systematic survey carried out in support of a program which maintains the space inventory current.

A desirable goal is compatibility with other internal systems, provincial, and national university space systems (149). In 1967 the Alberta Universities Commission hired the consultant firm Taylor, Lieberfeld and Heldman to establish a provincially compatible system of space definitions (219). This space system divides space into seven broad classifications with 600 use categories which are elemental data definitions, e.g. seminar room, drafting room or radio studios. Twenty-two function codes such as

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[1] Office of Institutional Research, Detailed Space Inventory Compiled as of September 1, 1970 for the Year 1970/71 (Non-Residential), Report 35 (Calgary: The University of Calgary, 1970); Detailed Space Inventory Arranged by Function Compiled as of September 1, 1970 for the Year 1970/71 (Non-Residential), Report 36 (Calgary: The University of Calgary, 1970); Detailed Space Inventory Compiled as of September 1, 1970 for the Year 1970/71, Report 37 (Calgary: The University of Calgary, 1970); Reduced Building Master Drawings, Report 48 (Calgary: The University of Calgary, 1971); Detailed Space Inventory Compiled as of December 1, 1971 for the Year 1971/72 (Non-Residential), Report 72 (Calgary: The University of Calgary, 1972).

instruction, research and housing are used to further define space. Computer listings of space can be organized in many ways as illustrated in Figure 1. Understanding and similar interpretation of data element definitions by different institutions is necessary for interuniversity exchange and comparison. Thus, correspondence was initiated by this office with the other universities to create an environment for the easy interface of space analysts at the working level[1] (219, 222).

Through seminars and continuing consultation, the Office has trained a unit within the university administrative organization to maintain the system. In support of this training, and to facilitate a comprehensive understanding of the system by its many users, the Office has produced a manual.[2] Since there is also a need to ensure the continued evolution of the space information system for the benefit of all users, the Office proposed the formation of the Space Information System Advisory Committee (SISAC) to the Vice-President (Services) and it was subsequently formed in early 1972.[3] The Office of Institutional Research is responsive to SISAC in a consultative capacity. The Committee may recommend on the development and evaluation of policies, regulations, systems and procedures for:

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[1]Letter from Bernard S. Sheehan to Vice-President (Academic) F. A. Campbell, The University of Calgary, January 4, 1971; letter from Bernard S. Sheehan, The University of Calgary, to Dr. W. A. Preshing, Director of the Office of Institutional Research and Planning, The University of Alberta, February 3, 1971.

[2]Office of Institutional Research, Space Management Manual, Version January, 1972, Report 73 (Calgary: The University of Calgary, 1972).

[3]Letter from Bernard S. Sheehan to Vice-President (Services) H. A. R. de Paiva, The University of Calgary, December 13, 1971. The Office of Institutional Research subsequently enlarged its recommendation in this area as described in the section on Information Systems.

Figure 1

LISTING BY BUILDING — SURVEY DATE: DECEMBER 1,1971 — DATE: JANUARY 26,1972 PAGE 43
OFFICE OF INSTITUTIONAL RESEARCH

BUILDING: ENGINEERING BLOCK A

ROOM NUMBER	LTH. FT	LTH. IN	WTH. FT	WTH. IN	ASF	NSF	CONTROL DEPARTMENT	USE CATEGORY	FUNCTION	STATIONS TYPE	STATIONS NO.
FLOOR LEVEL 01											
1C6D	10	9	9	0	99	99	ENGINEERING-ELECTRICAL	TCH & GRAD ASST OFFICES	RESEARCH		
1C6E	10	9	7	9	83	83	ENGINEERING-ELECTRICAL	TCH & GRAD ASST OFFICES	RESEARCH		
1C6Z	34	3	7	3		190	ENGINEERING-ELECTRICAL	CORRIDORS	CIRCULATION		
121	41	3	21	9	1,882	1,882	ENGINEERING-ELECTRICAL	CLASS LAB-WET	INSTRUCTION		32
123	13	0	6	3	93	93	ENGINEERING-ELECTRICAL	OTHER GRAD STUDENT OFF	RESEARCH		
125	14	0	7	9	125	125	ENGINEERING-ELECTRICAL	OTHER GRAD STUDENT OFF	RESEARCH		
127	12	0	8	3	98	98	ENGINEERING-ELECTRICAL	OTHER GRAD STUDENT OFF	RESEARCH		
129	39	0	36	0	1371	1371	ENGINEERING-ELECTRICAL	CLASSROOMS	INSTRUCTION	8	35
131	49	3	28	6	1409	1409	ENGINEERING-ELECTRICAL	CLASSROOMS	INSTRUCTION	8	25
133	12	0	10	9	129	129	ENGINEERING-ELECTRICAL	TCH & GRAD ASST OFFICES	RESEARCH		

TOTAL AREA FOR FLOOR 01 9,924 18,061
GROSS AREA FOR FLOOR 01 19,594
ASSIGNABLE AS A PERCENT OF GROSS 90.8%

FACULTY OF ARTS & SCIENCE — LISTING BY DEPARTMENT — SURVEY DATE: DECEMBER 1,1971 — DATE: JANUARY 26,1972 PAGE 11
OFFICE OF INSTITUTIONAL RESEARCH

ROOM NUMBER	LTH. FT	LTH. IN	WTH. FT	WTH. IN	ASF	NSF	BUILDING	USE CATEGORY	FUNCTION	STATIONS NO.	STATIONS TYPE
CONTROL DEPARTMENT: ARCHAEOLOGY											
175 1	31	6	13	3	210	420	SCIENCE IIIB	TCH & GRAD ASST OFFICES	RESEARCH		
175 4	31	6	13	3	210		SCIENCE IIIB	READING,STUDY ROOMS	RESEARCH		
176	14	3	9	6	156	156	SCIENCE IIIB	TCH & GRAD ASST OFFICES	RESEARCH		
178	13	3	10	9	141	141	SCIENCE IIIB	TCH & GRAD ASST OFFICES	RESEARCH		
TOTAL: ARCHAEOLOGY							11,106 ASSIGNABLE SQ. FT.				
CONTROL DEPARTMENT: BIOLOGY											
3E	16	9	6	3	104	104	SCIENCE A	ELECTRON MICROSCOPE-SUP	RESEARCH		
12 1	9	0	8	0	36	72	SCIENCE A	LAB COLD ROOM	RESEARCH		
105	30	6	29	9	854	854	SCIENCE A	CLASS LAB-WET	INSTRUCTION	10	
105A	8	6	6	6	55	55	SCIENCE A	FACULTY OFFICES	INSTRUCTION		
107 1	20	0	15	0	100	302	SCIENCE A	TCH & GRAD ASST OFFICES	RESEARCH		
107 4	20	0	15	0	100		SCIENCE A	OTH GRAD RESEARCH SPACE	RESEARCH		
107 7	20	0	15	0	102		SCIENCE A	FACULTY RESEARCH SPACE	RESEARCH		

LISTING BY FUNCTION — SURVEY DATE: DECEMBER 1,1971 — DATE: JANUARY 26,1972 PAGE 17
OFFICE OF INSTITUTIONAL RESEARCH

FUNCTION: INSTRUCTION

ROOM NUMBER	LTH. FT	LTH. IN	WTH. FT	WTH. IN	ASF	NSF	BUILDING	CONTROL DEPARTMENT	USE CATEGORY	STATIONS NO.	STATIONS TYPE
224	16	6	11	3	167	167	CALGARY HALL BLOCK D	ROMANCE LANGUAGES	SUPP ADMIN & SEC OFFICES		
224A	12	0	12	6	164	164	CALGARY HALL BLOCK D	ROMANCE LANGUAGES	DEPT HEAD/DIRECTOR OFFICE		
226	5	6	3	3	18	18	CALGARY HALL BLOCK D	ROMANCE LANGUAGES	OFFICE SUPPLIES - STORAGE		
227	21	9	14	6	317	317	CALGARY HALL BLOCK D	ROMANCE LANGUAGES	GROUP CONF ROOM	12	
208 A	50	6	24	0	865	1,153	CALGARY HALL BLOCK E	ROMANCE LANGUAGES	LANGUAGE LABORATORIES	48	
208 A	4	0	2	0	6	8	CALGARY HALL BLOCK E	ROMANCE LANGUAGES	LAB PREPARATION - STORAGE		
208B A	6	0	2	0	9	12	CALGARY HALL BLOCK E	ROMANCE LANGUAGES	LAB PREPARATION - STORAGE		
211B	9	9	9	6	93	93	CALGARY HALL BLOCK E	ROMANCE LANGUAGES	OFFICE STORAGE		
211C	10	3	11	3	111	111	CALGARY HALL BLOCK E	ROMANCE LANGUAGES	FACULTY OFFICES		
212 A	40	6	24	0	726	967	CALGARY HALL BLOCK E	ROMANCE LANGUAGES	LANGUAGE LABORATORIES	36	
212A A	17	9	10	0	132	175	CALGARY HALL BLOCK E	ROMANCE LANGUAGES	LABORATORY DEMONSTRATION		
212B A	4	0	2	0	6	8	CALGARY HALL BLOCK E	ROMANCE LANGUAGES	LAB PREPARATION - STORAGE		

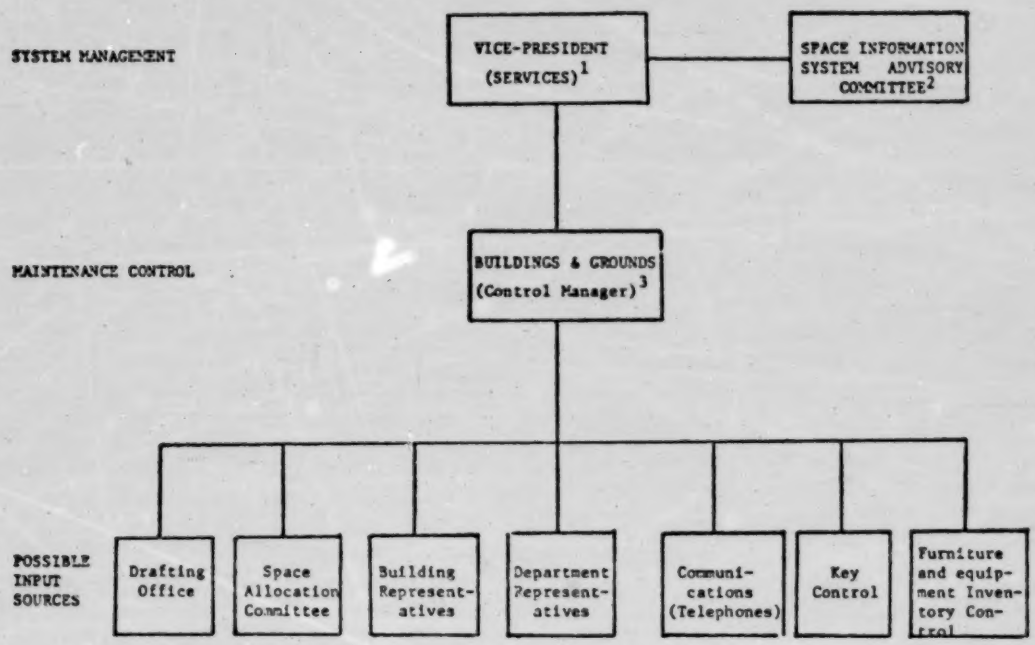
TOTAL DEPARTMENT: ROMANCE LANGUAGES 5,193 ASSIGNABLE SQUARE FEET

a) defining controlled access to the information stored on the system;
b) modifying information retrieval/formatting software used on the system;
c) updating information regularly collected and stored by the system;
d) adding new data elements or information to the system;
e) modifying the file structure, and
f) writing on the file in any way.

An initial space inventory may be accurate but it quickly becomes valueless if it is not maintained. The University of Calgary inventory maintenance system structure should meet the requirements of most higher education institutions and is outlined in Figure 2.

Figure 2

MAINTENANCE INVENTORY SYSTEM STRUCTURE



[1] Responsible for overall management of the system.

[2] Provides advice to the Vice-President (Services) and is the medium for interface of various users with the system.

[3] Collates input data, updates Master Space File, and publishes routine reports.

Space Planning

Since 1968 The University of Calgary has used a formal methodology[1] as the basis of its space planning processes[2] (219, 128). Given the space inventory and projected student enrolments as described in Section I, the current space planning sequence[3] is summarized by the following steps:

a) project weekly student hour matrix;
b) calculate divisional space needs;
c) develop space need priority schedule;
d) establish priorities and initiate buildings planning process.

This space planning sequence has the approval of the Universities Commission. Its annual application by the Services Policy Committee guarantees that the legitimate space needs of each space planning division (department) and the university as a whole are determined (128).

a) Project weekly student hour matrix -- Based on historical patterns of weekly student hours by teaching department, instruction type, and level, as generated by students registered in a particular faculty, projections (227) are made for each future year under review and incorporate certain assumptions, expected changes in historical trends, or changes in policy variables. A sample weekly student hour matrix for a certain year is given in Figure 3.

b) Calculate divisional space need -- Using space planning formulae

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[1] Academic Planning Committee, A Plan for the Development of Physical Facilities at The University of Calgary, Report 3 (Calgary: The University of Calgary, 1968).

[2] Office of Institutional Research, Space Planning Information, Report 59 (Calgary: The University of Calgary, 1971).

[3] Office of Institutional Research, Space Management Manual, Version: January 1972, Report 70 (Calgary: The University of Calgary, 1972).

the total space needs of the university are calculated for each space planning division. The total space need of any space planning division equals the sum of the space needs generated in the following categories:

lower level lab space upper level lab space graduate lab space	Space Planning Division Instructional space needs
full-time equivalent faculty space graduate teaching assistant space postdoctoral space other graduate space	Space Planning Division Staff space needs

The total need for the university equals the sum of the space planning divisional needs plus:

academic support space general classroom space library space physical education recreational space plant and administration space	University-wide space needs

The current University of Calgary space factors are shown in Figure 4. The value of an instructional space factor, for example, is determined by the following formula:

$$\text{space factor} = \frac{\text{station size}}{\frac{\text{weekly class hours}}{\text{room}} \times \text{station utilization}}$$

Each of the three elements is a policy variable and can be set by the appropriate policy committee. The current values of the instructional space factors used at The University of Calgary were determined after considerable research[1] by an independent consultant and are used as the basis

[1] Academic Planning Committee, Academic and Space Plans, Report 8 (Edmonton: The University of Alberta, 1967).

Figure 3

WEEKLY STUDENT HOURS
SPACE PLANNING DIVISION AND LEVEL

SPACE PLANNING DIVISION	LOWER LEVEL NON-LAB.	UPPER LEVEL NON-LAB.	LOWER LEVEL LABORATORY	UPPER LEVEL LABORATORY	GRADUATE LEVEL NON-LAB.	GRADUATE LEVEL LABORATORY
Anthropology	2039	945	-	12	48	15
Archaeology	818	569	683	217	181	35
Art	2377	2125	1357	997	29	20
Biology	2581	4614	2581	2949	145	147
Business	2434	3661	435	-	8	-
Chemistry	2758	1930	2168	1901	268	74
Classics	356	213	-	-	12	-
Drama	369	1013	556	1132	12	15
Economics	3730	3290	-	-	268	-
Education	2557	14672	740	2100	1049	332
Engineering	2335	6326	921	2103	614	9
English	4732	4626	-	-	309	
Geography	1629	1575	783	338	334	63
Geology	1035	1751	652	1111	216	79
Germanic & Slavic Studies	531	653	315	38	71	2
History	1553	3739	-	-	156	-
Linguistics	1068	429	-	2	27	-
Mathematics	9747	6050	1477	540	360	47
Music	953	954	548	290	-	-
Nursing	362	-	256	-	-	-
Philosophy	2376	1224	-	-	128	-
Physical Education--Academic	893	3033	1340	1993	2	-
Physics	2774	1284	1964	481	45	6
Political Science	1106	1958	-	-	128	-
Psychology	3280	4836	452	736	299	170
Romance Studies	1795	1416	751	273	96	10
Social Welfare	-	102	-	-	517	338
Sociology	2828	4748	-	170	145	56

for various applications by all Alberta universities and the Alberta Universities Commission (219, 279).

c) Develop space need priority schedule -- The priorities for new space are determined by identifying the space planning division with the greatest need based on comparison of computed need to present inventory.

Figure 4

TABLE OF SPACE FACTORS

SPACE PLANNING DIVISION	FACULTY AND STAFF NUMBERS B3	B4	B5	LABORATORY SPACE FACTORS C3	C4	C6	FACULTY AND STAFF SPACE FACTORS C7	C8	C9	C10
Anthropology	3.3	0.90	0.08	3.60	5.47	14.38	282	77	115	35
Archaeology	2.8	1.30	0.40	3.25	6.80	20.84	510	172	183	118
Art	3.3	0.90	0.08	2.98	5.95	9.73	369	225	219	175
Biology	2.8	1.30	0.40	2.60	5.10	16.20	738	267	250	200
Business	4.3	0.75	0.08	3.48	5.95	31.25	438	88	125	38
Chemistry	2.8	1.30	0.40	3.25	6.80	20.84	738	267	250	200
Classics	3.3	0.90	0.08	3.60	5.47	14.38	282	77	115	35
Drama	3.3	0.90	0.08	2.98	5.95	9.73	369	225	219	175
Economics	3.3	0.90	0.08	3.60	5.47	14.38	282	77	115	35
Education	6.2	0.60	0.04	3.48	7.94	15.63	438	88	125	38
Engineering	5.1	1.00	0.30	7.24	14.46	37.50	797	342	338	270
English	3.3	0.90	0.08	2.88	7.30	28.75	282	77	115	35
Geography	2.8	1.30	0.40	3.25	6.80	20.84	510	172	183	118
Geology	2.8	1.30	0.40	3.25	6.80	20.84	738	267	250	200
Germanic & Slavic Studies	3.3	0.90	0.08	2.88	7.30	28.75	282	77	115	35
History	3.3	0.90	0.08	3.60	5.47	14.38	282	77	115	35
Linguistics	3.3	0.90	0.08	2.88	7.30	28.75	282	77	115	35
Mathematics	2.8	1.30	0.40	2.39	4.38	28.75	282	77	115	35
Music	3.3	0.90	0.08	2.98	5.95	9.73	369	225	219	175
Nursing	6.2	0.60	0.04	3.48	7.94	15.63	438	88	125	38
Philosophy	3.3	0.90	0.08	3.60	5.47	14.38	282	77	115	35
Physical Education--Academic	6.2	0.60	0.04	0.00	0.00	0.00	438	88	125	38
Physics	2.8	1.30	0.40	3.25	6.80	20.84	738	267	250	200
Political Science	3.3	0.90	0.08	3.60	5.47	14.38	282	77	115	35
Psychology	2.8	1.30	0.40	5.00	6.85	15.55	504	174	150	120
Romance Studies	3.3	0.90	0.08	2.88	7.30	28.75	282	77	115	35
Social Welfare	3.3	0.90	0.08	3.60	5.47	14.38	282	77	115	35
Sociology	3.3	0.90	0.08	3.60	5.47	14.38	282	77	115	35

Academic Support	13 square feet per full-time non-medical student
General Classrooms	12 square feet per full-time non-medical student
Library	15 square feet per full-time non-medical student
Physical Education--Recreational	7 square feet per full-time non-medical student
Plant and Administration	15 square feet per full-time non-medical student

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B3--Full-Time Equivalent Faculty per 1000 Weekly Student Hours; B4--Graduate Teaching Assistant per Full-Time Equivalent Faculty; B5--Postdoctoral Fellow per Full-Time Equivalent Faculty; C3--square feet per Lower Level Laboratory Weekly Student Hours; C4--square feet per Upper Level Laboratory Weekly Student Hours; C6--square feet per Graduate Level Laboratory Weekly Student Hours; C7--square feet per Full-Time Equivalent Faculty; C8--square feet per Graduate Teaching Assistant; C9--square feet per Postdoctoral Fellow; C10--square feet per Other Graduate Student.

The space planning division with first priority is recommended to receive an amount of new space which will increase the inventory to the computed need in the following year. New space is recommended for each succeeding space planning division on the priority scale until the university's total recommended inventory equals total computed need.

d) Establish priorities and initiate buildings planning process -- The Services Policy Committee uses the priority schedule as a guide in its decision-making process to establish the space priorities and make recommendations which initiate the construction process (222).

The space planning sequence as described is unique to The University of Calgary (224). It serves the dual purpose of short- and long-range planning, allowing for subjective analysis based on objective formulae. The Services Policy Committee is at present reviewing the space planning methodology in an attempt to discover areas in which improvements can be made.[1] Specific considerations include the elements of the space factors.[2] Procedures will also be developed to initiate periodic review and revision to the space planning methods (224). Any changes in academic policy or external constraints will therefore be accommodated as they occur.

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[1]Office of Institutional Research, "Proposal of Procedures for Review of The University of Calgary Space Planning Methods," Internal Report 43i (Calgary: The University of Calgary, 1972).

[2]Office of Institutional Research, Working Papers for Space Formulae Analysis, Report 44 (Calgary: The University of Calgary, 1970).

Space Utilization

The Office of Institutional Research has developed a system that makes utilization information (251) available[1] to measure how well the University uses its physical facilities to provide the desired level of educational service (112, 219). Figures 5, 6, and 7 illustrate typical reports from this system. The Master Timetable File and the Master Space Inventory File are basic to the system. Their independent design for other purposes illustrated the fundamental need for compatibility of all data files in support of a management information system, and corroborated the wisdom for formation of an advisory committee to guide their continued evolution and use.

The expression of utilization is depicted by three fundamental parameters:

Room Utilization - the hours scheduled per week expressed as a percentage of available hours.

Station Utilization When Room in Use - the average number of seats used per scheduled hour in a classroom expressed as a percentage of the total number of seats.

Utilization Product - the product of the two parameters listed above.

Utilization studies can directly influence space use by permitting planners to allocate these facilities to the greatest benefit of students and faculty within the bounds of inevitable constraints. Specifically,

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[1]Office of Institutional Research, General Purpose and Special Classroom Utilization Study for 1967/68, 1968/69 and 1969/70, Report 25 (Calgary: The University of Calgary, 1970); Classroom and Classroom Laboratory Utilization Study for 1970/71, Report 75 (Calgary: The University of Calgary, 1972); Comparative Classroom and Classroom Laboratory Utilization Study 1967-1972, Report 80 (Calgary: The University of Calgary, 1972).

Figure 5

OFFICE OF INSTITUTIONAL RESEARCH

07/19/72 CLU-CL24-01C — ROOM HOURS PER WEEK BY ROOM NUMBER AND DEPARTMENT BY BUILDING — PAGE 1 — TERM - FIRST

BLDG	ROOM NUMBER	CONTROL DEPARTMENT	ROOM TYPE	TIME FRAME	ROOM HOURS BY DEPARTMENT		TOTAL ROOM HOURS	PERCENT UTIL
A	0012H	PSYCHOLOGY	OTHER	DAYTIME	PSYCHOLOGY	2.00	2.00	3.70
A	0051	PSYCHOLOGY	CLASS	DAYTIME	PSYCHOLOGY	20.00	20.00	37.03
A	0051A	PSYCHOLOGY	OTHER	DAYTIME	PSYCHOLOGY	6.00	6.00	11.11
A	014C	REGISTRAR	CLASS	DAYTIME	PSYCHOLOGY	7.00	11.00	20.37
A	014C	REGISTRAR	CLASS	DAYTIME	NURSING SCHL	4.00		
A	014C	REGISTRAR	CLASS	EVENING	PSYCHOLOGY	2.00	2.00	8.00
A	0143	REGISTRAR	CLASS	DAYTIME	GEOGRAPHY	2.00	23.00	42.59
A	0143	REGISTRAR	CLASS	DAYTIME	PSYCHOLOGY	21.00		
A	0212	CLASSICS	OTHER	DAYTIME	CLASSICS	3.00	3.00	5.55
A	0215	CLASSICS	OTHER	DAYTIME	CLASSICS	3.00	3.00	5.55
A	0218	CLASSICS	OTHER	DAYTIME	CLASSICS	3.00	3.00	5.55
A	022C	CLASSICS	OTHER	DAYTIME	CLASSICS	3.00	3.00	5.55
A	0232A	PSYCHOLOGY	OTHER	DAYTIME	PSYCHOLOGY	1.00		

OFFICE OF INSTITUTIONAL RESEARCH

CLU-CL21-01D — ROOM HOURS PER WEEK BY CLASS SIZE AND ROOM SIZE FOR EACH DEPARTMENT OR FACULTY BY BUILDING — PAGE 1

A. CLASSROOMS

CAPACITIES: CLASS (A) 001-025, (B) 026-050, (C) 051-100, (D) 101-999; ROOM (E) 001-025, (F) 026-050, (G) 051-100, (H) 101-999 — TERM: FIRST DAYTIME

DEPARTMENT	BUILDING	CLASS SIZE A	B	C	D	TOTAL	ROOM SIZE E	F	G	H	TOTAL
ENGLISH (CONT)	33C	3.0	13.0	0.0	0.0	16.0	0.0	3.0	3.0	0.0	16.0
	34H	24.0	18.0	0.0	0.0	42.0	0.0	30.0	0.0	0.0	42.0
		201.0	171.0	0.0	0.0	372.0	45.0	300.0	27.0	0.0	372.0
GEOGRAPHY	ART	3.0	0.0	0.0	0.0	3.0	0.0	3.0	0.0	3.0	3.0
	CH C	30.0	0.0	0.0	0.0	30.0	0.0	6.0	24.0	0.0	30.0
	CH D	20.0	0.0	0.0	0.0	20.0	20.0	0.0	0.0	0.0	20.0
	CH E	17.0	0.0	0.0	0.0	17.0	17.0	0.0	0.0	0.0	17.0
	ED C	3.0	0.0	0.0	0.0	3.0	3.0	0.0	0.0	0.0	3.0
	ENG C	0.0	4.0	0.0	0.0	4.0	0.0	4.0	0.0	0.0	4.0
	ENG D	0.0	3.0	0.0	0.0	3.0	0.0	3.0	0.0	0.0	3.0
	FSC	0.0	3.0	0.0	0.0	3.0	0.0	3.0	0.0	0.0	3.0
	33H	5.0	0.0	0.0	0.0	5.0	0.0	5.0	0.0	0.0	5.0
		89.0	14.0	0.0	6.0	89.0	40.0	5.0	30.0	14.0	89.0

OFFICE OF INSTITUTIONAL RESEARCH

06/19/72 CLU-CL25-01C — LECTURE AND LAB ROOM HOURS BY ROOM NUMBER AND DEPARTMENT — PAGE 1 — TERM - FIRST

CONTROLLING DEPARTMENT	BLDG	ROOM NUMBER	ROOM TYPE	TIME FRAME	LECTURE ROOM HOURS	UTIL.	LAB ROOM HOURS	UTIL.	TOTAL ROOM HOURS	UTIL.
ARCHAEOLOGY	5A	0147H	OTHER	DAYTIME	4.00	11.11	0.00	0.00	4.00	11.11
ARCHAEOLOGY	55B	0111	LAB	DAYTIME	3.00	5.55	14.00	25.92	17.00	31.48
ARCHAEOLOGY	55B	0111	LAB	EVENING	0.00	0.00	4.00	16.00	4.00	16.00
ARCHAEOLOGY	55B	0113	CLASS	DAYTIME	9.00	16.66	12.00	22.22	21.00	38.88
ARCHAEOLOGY	55B	0117	CLASS	EVENING	6.00	24.00	6.00	24.00	12.00	48.00
ARCHAEOLOGY	55B	0152	OTHER	DAYTIME	6.00	11.11	0.00	0.00	6.00	11.11
BIOLOGY	5A	0105	LAB	DAYTIME	0.00	0.00	27.00	50.00	27.00	50.00
BIOLOGY	5A	0116	OTHER	DAYTIME	0.00	0.00	3.00	5.55	3.00	5.55
BIOLOGY	5A	0120	LAB	DAYTIME	0.00	0.00	15.00	27.77	15.00	27.77
BIOLOGY	5A	0121	OTHER	DAYTIME	3.00	5.55	0.00	0.00	3.00	5.55
BIOLOGY	5A	0139	LAB	DAYTIME	3.00	6.66	24.00	44.44	24.00	44.44
BIOLOGY	5A	0143	LAB	DAYTIME	0.00	0.00	32.00	59.25	32.00	59.25
BIOLOGY	5A	0169	LAB	DAYTIME	1.00	1.85	12.00	22.22	13.00	24.07
BIOLOGY	5A	0201	LAB	DAYTIME	0.00	0.00	30.00	50.00	30.00	50.00
BIOLOGY	5A	0201C	LAB	DAYTIME	0.00	0.00	18.00	33.33	18.00	33.33
BIOLOGY	5A	0234	LAB	DAYTIME	0.00	0.00	27.00	50.00	27.00	50.00
BIOLOGY	5A	0234	LAB	EVENING	0.00	0.00	3.00	12.00	3.00	12.00
BIOLOGY	5A	0240	LAB	DAYTIME	0.00	0.00	39.00	72.22	39.00	72.22
BIOLOGY	5A	0240	LAB	EVENING	0.00	0.00	3.00	12.00	3.00	12.00
BIOLOGY	5A	0241	LAB	DAYTIME	0.00	0.00	33.00	61.11	33.00	61.11
BIOLOGY	5A	0241	LAB	EVENING	0.00	0.00	3.00	12.00	3.00	12.00
BIOLOGY	5A	0265	LAB	DAYTIME	3.00	5.55	7.00	14.00	10.00	18.51
BIOLOGY	5B	0104	LAB	DAYTIME	0.00	0.00	6.00	11.11	6.00	11.11
BIOLOGY	5B	0134	LAB	DAYTIME	0.00	0.00	16.00	32.00	16.00	32.00
BIOLOGY	5B	0134	LAB	EVENING	0.00	0.00	8.00	32.00	8.00	32.00

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Figure 6

CLU-CL22-01C — OFFICE OF INSTITUTIONAL RESEARCH — PAGE 1 -A

JULY 18, 1972 — ROOM HOURS PER WEEK BY TIME OF DAY FOR EACH DEPARTMENT OR FACULTY BY BUILDING — TERM: FIRST

A. CLASSROOM

DEPARTMENT	BLDG	8:00	MORNING 9:00	ROOM HOURS 10:00	11:00	12:00	TOTAL MORNING	1:00	AFTERNOON 2:00	ROOM HOURS 3:00	4:00	5:00	TOTAL AFTERNOON	TOTAL DAY
ARCHAEOLOGY	ED C	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	3.0	3.0
ARCHAEOLOGY	ENGE	0.0	1.0	2.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0
ARCHAEOLOGY	SC A	0.0	0.0	0.0	0.0	3.0	3.0	3.0	0.0	0.0	0.0	0.0	3.0	6.0
ARCHAEOLOGY	SC B	0.0	3.0	3.0	0.0	0.0	6.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0
ARCHAEOLOGY	SSC	3.0	0.0	0.0	3.0	0.0	6.0	0.0	0.0	0.0	4.0	3.0	9.0	15.0
ARCHAEOLOGY	SC3B	2.0	5.0	2.0	5.0	1.0	15.0	0.0	5.0	3.0	2.0	2.0	12.0	27.0
BIOLOGY	SC A	0.0	3.0	0.0	2.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0
BIOLOGY	SC B	1.0	3.0	9.0	7.0	4.0	24.0	3.0	3.0	3.0	3.0	0.0	12.0	36.0
BIOLOGY	STN	9.0	6.0	0.0	3.0	1.0	19.0	7.0	3.0	3.0	9.0	1.0	23.0	42.0

CLU-CL23-01C — OFFICE OF INSTITUTIONAL RESEARCH — PAGE 16

NUMBER OF CLASSES BY DEPARTMENT, SIZE AND LEVEL AND THE NUMBER OF HOURS SCHEDULED IN CLASSROOMS BY SIZE RANGE — TERM: FIRST

NUMBER OF STUDENTS IN CLASS - 004-006 LEVEL - UPPER LEVEL TIME: DAYTIME

DEPARTMENT	NO. OF CLASSES	NO. OF ROOM HOURS	NUMBER OF HOURS SCHEDULED IN CLASSROOMS 001-010	011-015	016-020	021-025	026-999	TOTAL	NO. OF HOURS NOT SCHEDULED IN CLASSROOMS LABS	OTHER
CHEMISTRY	1	3.0	0.0	0.0	0.0	3.0	0.0	3.0	0.0	0.0
CLASSICS	1	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0
ENGLISH	8	24.0	0.0	0.0	0.0	12.0	6.0	18.0	0.0	6.0
GEOGRAPHY	1	3.0	0.0	0.0	0.0	0.0	3.0	3.0	0.0	0.0
GERMANIC&SLVS	2	6.0	0.0	3.0	0.0	3.0	0.0	6.0	0.0	0.0
HISTORY	5	15.0	0.0	3.0	3.0	0.0	9.0	15.0	0.0	0.0
LINGUISTICS	1	3.0	0.0	0.0	3.0	0.0	0.0	3.0	0.0	0.0
MATHEMATICS	3	8.0	0.0	0.0	5.0	3.0	0.0	8.0	0.0	0.0
PHILOSOPHY	4	8.0	0.0	4.0	0.0	3.0	1.0	8.0	0.0	0.0
PHYSICS	5	11.0	0.0	7.0	1.0	0.0	3.0	11.0	0.0	0.0
POLITICAL SC	2	6.0	0.0	0.0	6.0	0.0	0.0	6.0	0.0	0.0
ROMANCE STUD	1	3.0	0.0	0.0	0.0	3.0	0.0	3.0	0.0	0.0
BUSINESS	1	3.0	0.0	0.0	0.0	0.0	3.0	3.0	0.0	0.0
EDUC PSYCH	1	1.5	0.0	0.0	0.0	0.0	1.5	1.5	0.0	0.0
ART	1	3.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0
DRAMA	3	7.0	0.0	4.0	0.0	0.0	2.0	6.0	0.0	1.0
MUSIC	1	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
PHYS ED SCHL	1	3.0	0.0	3.0	0.0	0.0	6.0	3.0	3.0	0.0

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Figure 7

CLU-CL20-01C OFFICE OF INSTITUTIONAL RESEARCH
JULY 4, 1972 UTILIZATION STUDY OF CLASSROOMS AND LABS PAGE 22

BUILDING - CH E ROOM NO. - 0110 TYPE - GENERAL CONTROL DEPT. - REGISTRAR TERM - FIRST

USEAGE - GEN PUR CLRM FUNCTION - INSTRUCTION NO. OF STATIONS - 36 DESIGN CAPACITY - 0038 AREA - 00544

NO. OF AVAILABLE STATION HOURS DAY- 1944 EVENING 900 TOTAL - 2844

TIME	AVERAGE NUMBER OF STATIONS USED PER SCHEDULED HOUR MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	ROOM HOURS SCHEDULED PER WEEK IN HALF HOUR INCREMENTS	STATION HOURS SCHEDULED PER WEEK (SSH) IN HALF HOUR INCREMENTS	AVERAGE NO. OF STATIONS USED PER SCHEDULED HOUR
8 00 A.M.	0	0	0	0	0	0	0.0	0.0	0.0
8 30 A.M.	0	0	0	0	0	0	0.0	0.0	0.0
9 00 A.M.	28	0	28	0	28	0	1.5	42.0	28.0
9 30 A.M.	28	31	28	31	28	0	2.5	73.0	29.2
10 00 A.M.	27	31	27	31	27	0	2.5	71.5	28.6
10 30 A.M.	27	31	27	31	27	0	2.5	71.5	28.6
11 00 A.M.	31	27	31	27	31	0	2.5	73.5	29.4
11 30 A.M.	31	27	31	27	31	0	2.5	73.5	29.4
12 00	30	27	30	27	30	0	2.5	72.0	28.8
12 30 P.M.	30	34	30	34	30	0	2.5	79.0	31.6
SUB TOTAL MORNING	4.0	3.5	4.0	3.5	4.0	0.0	19.0	556.5	233.6
1 00 P.M.	30	34	30	34	30	0	2.5	79.0	31.6
1 30 P.M.	30	34	30	34	30	0	2.5	79.0	31.6
2 00 P.M.	37	24	37	24	37	0	2.5	79.5	31.8
2 30 P.M.	37	24	37	24	37	0	2.5	79.5	31.8
3 00 P.M.	32	24	32	24	32	0	2.5	72.0	28.8
3 30 P.M.	32	15	32	15	32	0	2.5	63.0	25.2
4 00 P.M.	20	15	20	15	20	0	2.5	45.0	18.0
4 30 P.M.	20	15	20	15	20	0	2.5	45.0	18.0
5 00 P.M.	0	19	0	19	0	0	1.0	19.0	19.0
5 30 P.M.	0	19	0	19	0	0	1.0	19.0	19.0
SUB TOTAL AFTERNOON	4.0	5.0	4.0	5.0	4.0	0.0	22.0	580.0	254.8
TOTAL DAYTIME	8.0	8.5	8.0	8.5	8.0	0.0	41.0	1136.0	488.4
6 00 P.M.	0	19	0	19	0	0	1.0	19.0	19.0
6 30 P.M.	0	0	0	0	0	0	0.0	0.0	0.0
7 00 P.M.	12	14	12	0	0	0	1.5	19.0	12.6
7 30 P.M.	12	14	12	0	0	0	1.5	19.0	12.6
8 00 P.M.	12	14	12	0	0	0	1.5	19.0	12.6
8 30 P.M.	0	14	0	0	0	0	0.5	7.0	14.0
9 00 P.M.	0	14	0	0	0	0	0.5	7.0	14.0
9 30 P.M.	0	14	0	0	0	0	0.5	7.0	14.0
10 00 P.M.	0	0	0	0	0	0	0.0	0.0	0.0
10 30 P.M.	0	0	0	0	0	0	0.0	0.0	0.0
SUB TOTAL EVENING	1.5	3.5	1.5	0.5	0.0	0.0	7.0	97.0	98.9
COMBINED	9.5	12.0	9.5	9.0	8.0	0.0	48.0	1233.0	587.3

	DAYTIME	EVENING	COMBINED
UTILIZATION OF AVAILABLE HOURS	75.92	28.00	60.75
STATION UTILIZATION WHEN ROOM IS IN USE	76.96	38.49	71.35
UTILIZATION PRODUCT	58.42	10.77	43.34

flexible programs provide monitoring of timetabling, ensure best fit of classes to rooms and ensure that planning norms are reasonably met.

Future considerations of space utilization data entail a classroom prediction model which, in the short term, can predict the number and size range of classrooms required for the fall term enrolment (227, 251). In the longer term, it could be an adjunct to the planning function of future space requirements and become an integral part of simulation models as discussed in Section V (153, 219).

There seems to be a widespread misunderstanding of the complicated nature of the university plant. Many suggestions are made from time to time on how university classroom, laboratory and other facility utilization can be improved. These suggestions usually fail to recognize that the nature of university activities places inherent limitations on both classroom space utilization[1] and the number of hours per day or week classrooms can be used economically (128). Donovan Smith, a space consultant to Alberta universities, has illustrated the futility of trying to improve classroom station utilization beyond 60%, a widely recognized standard.[2] He has also shown that beyond a certain break-even point, it is uneconomical to increase the number of hours existing classrooms are used as an

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[1]The OIR has done some preliminary study of the problem of developing a set of criteria for comparing space utilization in universities and other buildings in the community, (OIR Internal Report 49i "Space Utilization in Business and Universities, Comparison"). Our initial results show that university space is used annually more heavily than business space. We plan to report the results of this work as it progresses.

[2]Donovan Smith, "Design and Methodology in Institutional Research," from C. Bagley, ed., Proceedings of the Fifth Annual National Institutional Research Forum, SUNY at Stony Brook, May 1965, pp. 125-128.

alternative to building new space [1] (219). Increasing the use of classroom space past a certain point results in escalating teaching and other operating costs beyond the annual amortization capital cost of new space (279).

University Year-Round Operation

Using the first computer simulation model for analyzing existing or projected year-round operation schemes (116-122), a Wright Commission study[2] reports that the conditions have to be optimum before even modest savings are accomplished. Achieving optimal conditions in average section size, plant utilization, balanced enrolment among the terms, and varying retention rates is virtually impossible without removing all flexibility from the student academic programs. Thus, the Wright Commission concludes that there are better means of achieving total unit cost reduction than year-round schemes. Beyond economic considerations, the Commission report noted that the loss of continuity due to year-round operations at Simon Fraser University resulted in alienation and lack of community amongst faculty and students. Many authors writing[3] in this area note the problem of fatigue under year-round operations since there is no natural slow time for either catch-up or vacations. According to the Wright Commission study, deans,

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[1] Donovan Smith, "Optimal Class Scheduling," presented at the 55th Annual Meeting of the American Association of Collegiate Registrars and Admissions Officers, Dallas, Texas, April 21 to 25, 1969.

[2] Commission on Post-Secondary Education in Ontario, Organization of the Academic Year: Report of the Commission on Post-Secondary Education in Ontario (Toronto, Ontario: Queen's Printer, 1972).

[3] Office of Institutional Research, University Year Round Operation: A Review of the Literature, Report 67 (Calgary: The University of Calgary, 1971).

registrars, controllers, and other administrators are particularly affected. The study found that students strongly approve of year-round operation flexibility, but ironically seldom elect nontraditional terms. Also, many faculty prefer the option of winter term away from the classroom, since certain research opportunities unavailable in the summer are open between September and June.

Facilities

Facilities are conveniences in buildings which support the learning environment. These include office equipment for administrative purposes, scientific equipment for instruction or research, and the desks and chairs in classrooms. To control facilities a capital equipment inventory system is needed. Unfortunately, the state of the art is not much beyond the embryonic stage and there has been no concerted effort to achieve a common Inventory Nomenclature Code Manual. However, Alberta Universities Commission queries to the Vice-President (Services) led the Office of Institutional Research[1] to propose a procedure to implement a capital equipment inventory system[2] (128).

In any system accounting for equipment there is a total cycle: demand, receipt, storage, maintenance, issue, accounting, and finally, disposal. The design must include all these elements, and be capable of

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[1]Letter from Dr. H. A. R. de Paiva to Bernard S. Sheehan, February 1, 1972 re "Capital Equipment Inventory System."

[2]Douglas T. Kenyon, Office of Institutional Research, "A Proposed Procedure Leading to the Implementation of a Capital Equipment Inventory System at The University of Calgary," Project No. 1109, March 1972.

achieving the following goals:

a) Provision of timely and accurate data
   - to meet the differing needs of users
   - to assist management in making sound decisions
   - to provide reports on historical or current data
   - to assist in capital planning decisions
b) Compatibility with The University of Calgary financial, student and space information systems.
c) Compatibility with other provincial university systems.
d) Enough flexibility to incorporate changes as further demands on the system come to light, e.g. determination of academic capital program costs.

Some system uses are:

a) Planning, provisioning, budgetary control, and disposal of capital equipment (227).
b) Measurement of physical utilization , maintenance and security of capital equipment.
c) Provision of control system for accomplishing a) and b).

Over the past five years about $70,000,000 has been spent on capital equipment at The University of Alberta and The University of Calgary and perhaps another $40,000,000 will be required over the next five years. Thus, compatibility of inventories, and even coordination to include all post-secondary institutions if relevant, would be a sound and responsible management consideration. Greater bulk buying, inter-loan of equipment, the movement (with appropriate amortized capital credit) from one post-secondary institution where need no longer exists to another, all seem worthwhile goals that could be achieved (219, 222).

SECTION IV

INFORMATION SYSTEMS

University Information Systems

The REPORT states: "The crucial importance of an adequate information base for planning and decision-making is undeniable" (229) and "In the design of information systems and data banks, it must be re-emphasized that educational planners will need to have access to data other than those encompassed by traditional educational statistics" (230). For the past three years, the Office of Institutional Research has served, in many ways, as the university management information system. This service is consistent with our terms of reference and has given us the opportunity to make first-hand observations about the need for improved management information as well as ways and means to stimulate developments toward that end. Recently, we noted:

> Our development work on the adaptation of modern management tools and techniques to the University has impressed on us the need for integrated and regularly maintained university information systems which can serve as a source of management information required for university decision-making and planning.[1]

There is a basic gap between the awareness of an important need and its satisfaction as recognized in the REPORT. "Information and indicators are of limited value unless there exists a systematic means for making that information available at the right place at the right time" (230). Closing this gap requires a clear definition of the problem. Problem definition is

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[1] Letter from Bernard S. Sheehan to President A. W. R. Carrothers, The University of Calgary, June 29, 1972.

initiated by understanding the three basic needs[1] to be satisfied by a university information system, which are:

a) to provide administrators with information about the day-to-day operations of the university;
b) to provide the supporting information required for both long and short-term planning by using the best available analytical techniques; and
c) to provide the accountability required by the government and other statistical and research agencies.

As The University of Calgary has evolved, 40 administrative systems with 400 computer programs have been developed. This advance has begun to satisfy the first need and started the data base to satisfy the second and third. The University is at the stage of systems development that requires the coordination of this basic operating system so that planning and decision-making information can be "available at the right place at the right time" (230). Figure 1 diagrams the relationships between the systems of an integrated university information system which supports the total university administrative function.

Time spent studying Figure 1 will develop an appreciation of the delicate balance that must be struck between the three basic components of an integrated university information system. The Management System is a continuous loop through goal setting, planning, action and measuring. The care and feeding of this top level Management System falls to the Management Information System. This system is made up of all the management

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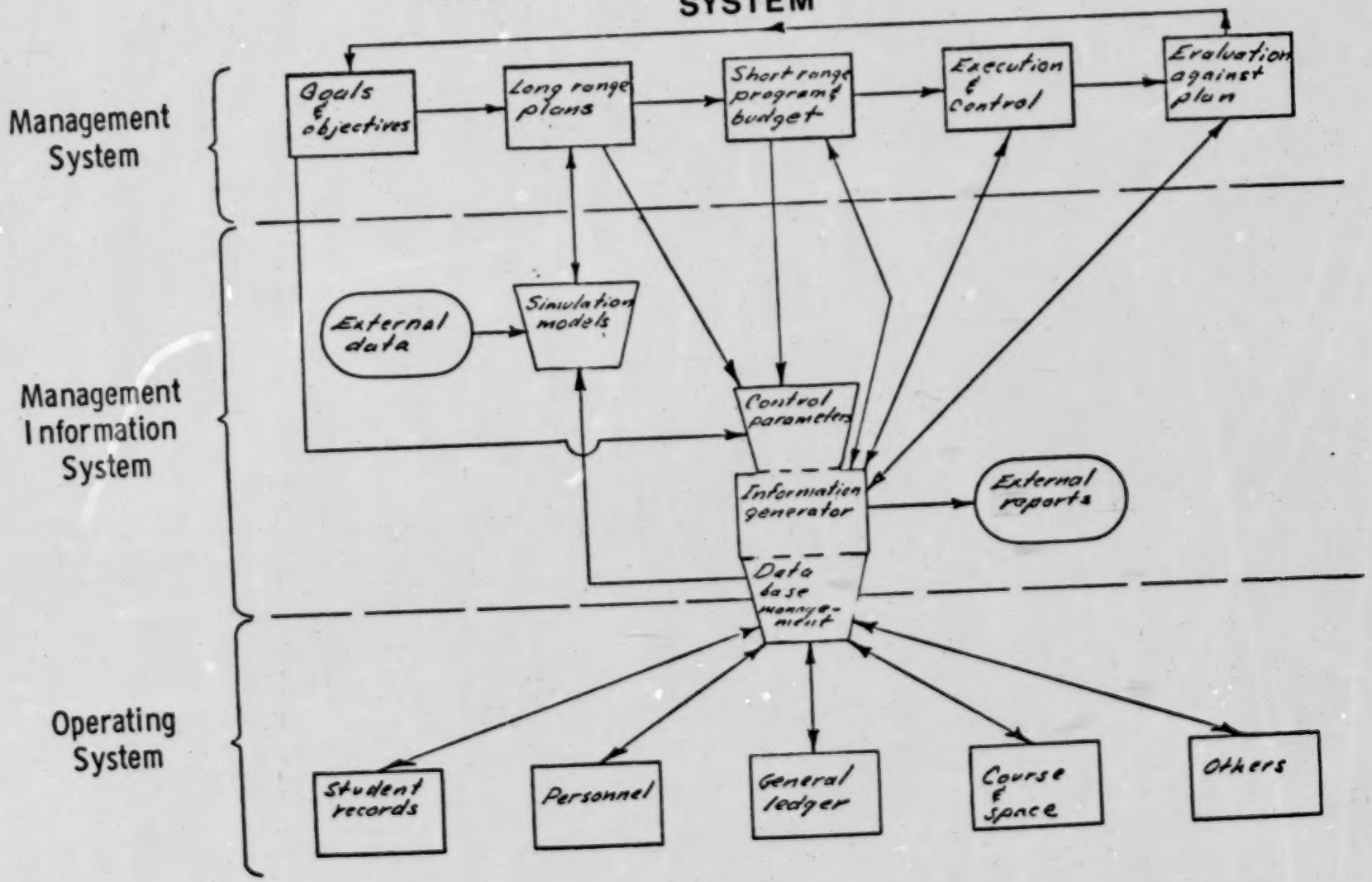
[1] D. J. Youston, R. B. Royiwsky, and M. Kunta, Decision-Making and University Information Systems: Analysis and Design (Toronto: University of Toronto, 1969).

Figure I
SYSTEMS INTERRELATIONSHIPS
of
INTEGRATED UNIVERSITY INFORMATION SYSTEM



tools and techniques that can be brought to bear on university management problems. These include simulation modeling, program budgeting, cost accounting, matched personnel deployment, and the myriad techniques that are used to keep tabs on the health and welfare of the university enterprise.

Without an effective Operating System that keeps the day-to-day routines of the university under control and supplies the basic data, the other two systems cannot hope to succeed. The careful planning and linking of these basic components and the capacity to access any one of them is fundamental to the effectiveness of the information system.

A most important aspect in the design of such integrated systems is the interrelationship of the operating systems files. This aspect must be kept in mind during the design of any one of the components of the information system and must be accommodated pragmatically with each design. The University is currently investigating packages which will serve as the data base management subsystem shown in Figure 1. Complexity, security and cost are criteria that have to be balanced against flexibility, facility and personnel dislocations in the choice of a particular package.

An understanding of the current university information system is needed to coordinate the development, design, and implementation of an integrated university information system. Therefore, the proposal for the study and inventory of information subsystems at The University of Calgary (Office of Institutional Research Project 1067)[1] was advanced. The

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[1]Office of Institutional Research proposal to President's Executive Advisory Committee, The University of Calgary, for Study of the Informational Systems of The University of Calgary, November 9, 1970.

methodology of this study was designed to involve systems users in what must be recognized to be a continuum from evaluation through problem definition, system modification design, and finally, implementation. We were interested in motivating the participants in the system towards the problem-solving implementation of the designs that would be forthcoming from the study.

A pilot study and inventory have been completed, and include the following steps:

a) Orientation of the participants on aspects of the study.
b) Interviewing the deans and department heads of a faculty and an operating department to solicit cooperation in the project and to collect basic information as to the structure of their portion of the administration.
c) Documentation--functional, organizational and procedural charting was used to document systems in detail. The DEFINE[1] charting technique proved of great value.
d) Review of charting with the study participants to make sure the charts conveyed what the staff meant to describe.
e) Inventory of information needs for operational systems, which were extracted from the various systems charts.
f) Review of study with deans, department heads and operational department heads. Documentation of the managerial systems of the "middle management" of the University was attempted at this point.

Interviewing of study participants, documentation of systems, examination and screening of data, and the identification of information needs (230) have confirmed the value of the modular approach. This approach gives short-range successes for the systems development as well as providing assistance in areas that need systems help. We have found that the advantages of having going systems in areas where the need is significant outweigh the disadvantages and delays of waiting for the larger system to be

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[1]Geoffrey S. Lyford, "The DEFINE System," Journal of Systems Management, (April, 1972), pp. 34-38.

designed.[1] Finally, we noted that general improvement in communications among its participants characterized the study.

As an operating system matures with the growth of the university, it evolves to supply better the needs of the managerial decision-making system. Therefore it is likely that the operating system will gradually contain more and more of the data base necessary to meet the informational demands of senior decision-makers.[2] The main objective of the OIR proposal was to hasten the coordinated evolution of this system in a rapidly growing university.

Senior decision-makers should be involved in and encourage the development of information systems which support them. Their involvement should generate faith in the systems and motivate all decision-makers to familiarize themselves with new management tools. Advisory committees seem necessary to guarantee senior administration of the user's advice on the development and use of important files and associated systems.[3] The Space Information System Advisory Committee (SISAC), described in Section III, has already proven a valuable aid in coordinating space information systems development with user needs and the development

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[1]Donald C. Bruegman and Jack Rust, "Building a Successful Management Information System: A Case History," 15th Machine Records Conference [Proceedings], (Miami, Florida, 1970).

[2]Bernard S. Sheehan, "Integrated University Management Information Systems," Institutional Research and Communications in Higher Education, ed. Patricia S. Wright (Berkeley: University of California, The Association for Institutional Research, 1970), pp. 181-188.

[3]Office of Institutional Research, University Information Systems, Report 79 (Calgary: The University of Calgary, June 1972).

of other information systems.

We favor a classification scheme that is "complementary within all phases of recurrent education, and to other public services and Statistics Canada" (229). Therefore, the Office of Institutional Research is studying the program classification structure set up by the National Center for Higher Education Management Systems (NCHEMS) at WICHE, Boulder, Colorado.[1] The establishment of a standard classification structure as well as standard data elements makes it possible more readily and inexpensively to use and exchange packaged models and computer software between universities. It also improves the comparability of data collected at different institutions.

The use of data element standards has been encouraged here on campus by the shared use of files on disk storage such as exists in the ASSIST[2] system and by shared use of the space and timetable files for space utilization studies. Although common data does exist between some users, there is not yet full assurance that common definitions of what appear to be similar data elements exist in all files. If, to take an interuniversity example, courses are eliminated in a given term on the basis of course size (212), the results would be different at the three Alberta universities because of differences in the definition of a course. At The University of Alberta, students can register repeatedly in one course studying a different topic while The

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[1] Warren W. Gulko, Program Classification Structure (first edition), Technical Report No. 27 (Boulder, Colorado: National Center for Higher Education Management Systems at WICHE, January 1972).

[2] Acronym for Arts and Science Student Information System--Terminal, which is a computer based terminal controlled information system developed and used by the Faculty of Arts and Science at The University of Calgary.

University of Calgary treats each such topic as a separate course.[1] Comparability of information must come from compatible definitions and procedures that make exchange and comparison meaningful. It was with this sort of problem in mind that we have become involved in various co-operative efforts (219) described in the following section.

Provincial/Regional/National Information Systems

The REPORT recognizes the need for a province-wide information system (232) and the need for the federal government to provide a comprehensive information service (149) in education. In our view, the most important problems are initial organization and definition of the system. A successful provincial, regional, or national system must be useful to the institutions if it is to be implemented effectively. We feel that existing ways of gathering information required to manage Canadian post-secondary educational institutions and systems are not adequate. Carefully planned national information systems for higher education are needed to provide decision-makers and policy formulators in institutions and governments with management information. Such systems have been proposed[2] and will require up to five years to implement. Implementation will be expensive, yet will be worth the cost because such a system will make the huge present and projected expenditures more effective. Since this proposal was made, there has been considerable progress and a national council will be named shortly.

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[1] Memorandum Margaret Reti to Bernard S. Sheehan, Office of Institutional Research, The University of Calgary, June 30, 1972.

[2] Bernard S. Sheehan, "Proposal for National Information System for Higher Education," The Journal of Educational Thought, Vol. 5, No. 3 (December, 1971), pp. 142-155.

For some time, Statistics Canada ran a pilot project in Ontario on student statistics. Recently Statistics Canada's University Student Information System,[1] which is conceived as a data base that will provide a Canada-wide system for university enrolment statistics, was implemented nationally. The data elements include items of educational and academic interest and a wide range of personal characteristics of individual students. Cross-tabulations of personal and educational characteristics should, according to Statistics Canada, provide the basis for a meaningful approach to educational and social planning. Also, Statistics Canada has a 21 Atlantic Universities Pilot Project[2] which is developing the "Atlantic Provinces University Financial Information System." This work and that of the Council of Ontario Universities in financial information systems and the continuing contributions of the Canadian Association of University Business Officers to this area are all important to the development of useful national university information systems. However, great effort must be expended to make these systems compatible.

Regionally, the presidents of all universities in Manitoba, Saskatchewan, Alberta, and British Columbia have named a task force on information needs and systems. The Task Force is charged to survey each of the western universities to ascertain the current state of development of all major information systems within each of the fourteen universities and to determine the potential for a meaningful exchange of information through comparable

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[1]Statistics Canada, "The University Student Information System," (Ottawa: February 1, 1972).

[2]Statistics Canada, Atlantic Provinces Universities Financial Information System, (Ottawa: 1971).

definitions and procedures. Each western Canadian university has a representative on the Task Force and the project is funded by the universities. Provincially, in Alberta, the Alberta Universities Commission has a Committee on Common Information Needs and Systems. Bernard S. Sheehan, Director of The University of Calgary Office of Institutional Research, is chairman of the Committee and the Task Force (219).

We agree that "initiative for collaboration, willingness to cooperate, and a free exchange of information must occur at every level. Such participation is a valuable safeguard against proscription and inhibition. It is also powerful stimulus for change" (219). The developments described in this section are the results of institutional initiatives and therefore have a much better chance of being ultimately useful to the universities, the provinces, and the nation than something which may, in the future, be imposed on the institutions. Without the enthusiastic support of people in the institutions, information systems and other potentially useful administrative changes will be ineffectual, costly failures. The Commission is right in asserting that enlightened coordination of post-secondary educational institutions allows the institutions control and flexibility (132) of their own affairs. It is therefore critical that educational managers at the institutional, provincial and national level have the information that will permit them to make decisions which will encourage and nurture coordinated and creative management within the institutions.

SECTION V

SIMULATION MODELS

The Commission acknowledges (261) that simulation techniques would have been useful in writing the REPORT. We agree, not so much on the basis of our own experience with institutional models as on the basis of approaches taken by the Club of Rome in building its world model[1] and by studies utilizing models to support the Wright Report in Ontario.[2] Also, we obviously agree that "Those institutions and jurisdictions with the resources to do so should make increasing use of simulation and computerized information systems" (219).

In our view, given the state of the art of modeling in universities and current institutional experience with analytical management tools, immediate benefits will result more from model design and experimental implementation than from operational model use in decision making and planning (227). The modeling process provides a structured method for instruction of management and support people in the value and use of analytical management tools (260). It tends to make institutional self-examination a routine process rather than an epochal event. Simulation of management processes can give decision-makers insight into the complicated relationships

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[1] Dennis L. Meadows et al., The Limits of Growth: A Report on the Club of Rome's Project on the Predicament of Mankind (New York: Universal Books, 1972).

[2] Commission on Post-Secondary Education in Ontario, Organization of the Academic Year (Toronto: Queen's Printer, 1972); and Cost and Benefit Study of Post-Secondary Education in Ontario, School Year 1968-69 (Toronto: Queen's Printer, 1972).

between costs, resource requirements and academic programs. Universities experimenting with simulation models are more susceptible to collateral developments in long-range planning, management information systems, planning, programming and budgeting systems, and the coordinated evolution of other campus operating and planning systems. These institutions are also likely to have more success in grappling with the problems of formal and substantive accountability. In short, modeling encourages the growth of logical management processes throughout the campus.

Improvement in completeness, accuracy and consistency of the institutional administrative data base usually accompanies experimentation with models[1] (230). Planning models supported by institutional files with compatible data elements are an important medium for improving communications and hence trust among all levels and groups interested in the planning process. The demands made on the data base by simulation are useful in isolating some of the technical problems of generating normative, comparable and compatible interinstitutional data. For many analysts and decision-makers, modeling experience is like a short course in the institution's recent history which enhances participants' ability to define campus management problems and formulate "what if" questions for further analysis. The potential of models as teaching aids should not be overlooked in the training and orientation of new management staff, including academic department heads and administrative assistants. Finally, the effort to develop the model and its integrated data base may pay off by providing an effective

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[1] These ideas are taken from a talk given by Bernard S. Sheehan to the Canadian Computer Conference, Montreal, June 2, 1972, and will appear in detail as: "Simulation Modeling in Institutional Research," McGill Journal of Education (Fall 1973), in press.

way of generating many of the ad hoc and routine reports required by university management as well as external agencies.

Experimental Planning Model

The University of Calgary has been aware of these benefits of modeling for some time. The Office of Institutional Research has developed a simple model which has proven useful for university budgeting. This model calculates for any given year university operating resource requirements by activity and department in terms of full-time equivalent academic and support staff, and determines the financial measurement of these resources and of supplies and sundries.[1] This model recognizes the varying activities of the university such as instruction and research. Each activity is viewed as having separate distinct outputs and related resource requirements.

The model inputs and their dimensions are listed in Figure 1. Each input can be viewed as a "policy parameter" since each is controllable by the institution.

The basic relationship of the model is:

$$FTE = \left(A \cdot \frac{1}{B} \cdot C \cdot \frac{1}{D}\right) + \left(E \cdot \frac{1}{D}\right)$$

where FTE = *instruction academic full-time equivalent*

All other model relationships are functions of the above.

The model produces several outputs at each of the following resource requirements levels within the university: department, faculty, faculties

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[1] Office of Institutional Research, "Experimental Planning Model," Internal Report 38i (Calgary: The University of Calgary, 1972).

Figure 1

MODEL INPUTS

INPUT VARIABLES	VARIABLE NAME	DIMENSION: INSTRUCTION LEVEL	DIMENSION: DEPARTMENT/ FACULTY
1. Section enrolees	A	x	x
2. Average section size	B	x	x
3. Section hours per section	C	x	x
4. Work load per academic FTE	D		x
5. Graduate students	E		x
6. Support FTE/Academic FTE	P		x
7. Average academic FTE salary	M		x
8. Average support FTE salary	N		x
9. Supplies and sundries/academic FTE	K		x
10. Department INSTRUCTION percent	I		x
11. Department RESEARCH percent	R		x
12. Department OTHER percent	O		x
13. Faculties and schools nonteaching department cost factors	$T_1, T_2, \ldots T_n$		x
14. University support department cost factors	$U_1, U_2, \ldots U_m$		x

and schools, and university support. Figure 2 shows the nature of these outputs and the related inputs for a hypothetical department.

Classroom Requirements Prediction Model

A classroom requirements prediction model is another currently under development in the Office of Institutional Research. This model determines the number and size range of classrooms required for fall term enrolment in sufficient time to influence pre-September timetabling (128). Eventually, as they are developed, models of this sort will be integrated into the normal timetabling, space scheduling and long-range space planning process of the university.

Figure 2

SAMPLE DEPARTMENT INPUT VARIABLES/OUTPUT STATISTICS

I. INPUT VARIABLES:

INSTRUCTION INPUTS	INSTRUCTION LEVEL JUNIOR	SENIOR	GRADUATE
Section Enrolees	1900	1300	75
Average Section Size	25.30	20.10	12.80
Section Hours/Section	2.80	3.50	3.30
Graduate Students			75

OTHER POLICY VARIABLES	VALUES
Work Load Parameter	13.85
Average Academic FTE Salary	$14,150
Average Support FTE Salary	$ 5,700
Support FTE/Academic FTE	.45
Supplies and Sundries/Academic FTE	$ 3,200
Percent Academic Instruction Effort	.60
Percent Academic Research Effort	.30
Percent Academic Other Effort	.10

II. OUTPUT STATISTICS

RESOURCE REQUIREMENTS	PROGRAMS INSTRUCTION	RESEARCH	OTHER	TOTAL
Staff Requirements				
Academic FTE	38.3	19.2	6.3	63.8
Support FTE	17.2	8.6	2.8	28.6
Financial Requirements				
Academic Salaries	$541,945	$271,680	$ 89,145	$902,770
Support Salaries	98,040	49,020	15,960	163,020
Supplies/Sundries	122,560	61,440	20,160	204,160
TOTAL	$762,545	$382,140	$125,265	$1,269,950

The following are model inputs:

a) Average number of hours per week classrooms are to be used (policy variable).
b) Percent station utilization when classroom in use (policy variable).
c) Number of hours per week classrooms are made available (policy variable).
d) Number of square feet allocated to each classroom station (policy variable).
e) Number of sections by size and average meeting hours per week.

Figure 3 is a sample output of data for the year 1971/72 showing the number of classrooms theoretically required for that year based on the assumed values of the policy variables. Similarly using normative data and relationships between weekly student hours generated, the number of section sizes, and hours, future classroom requirements can be determined.

Resource Requirements Prediction Model

In March, 1972, The University of Calgary hosted a three-day seminar on higher education management, sponsored by the Association of Universities and Colleges of Canada. The seminar was attended by a hundred senior university administrators from across Canada and was conducted by the staff of the National Center for Higher Education Management Systems (NCHEMS) at the Western Interstate Commission for Higher Education (WICHE) at Boulder. This is the first such seminar held outside the United States and is indicative of the leadership role assumed by this University and the continuing interest shown by all universities in Alberta, the Alberta Universities Commission, and the Alberta Colleges Commission (227) in the field of modern management science in higher education.

The model discussed at the Calgary AUCC-WICHE Seminar was the Resource Requirements Prediction Model (RRPM). First work on the RRPM

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Figure 3

CLU-CL27-01C — THE OFFICE OF INSTITUTIONAL RESEARCH — PAGE 2

10/04/72 — SPACE PREDICTION MODEL - CLASSROOM REQUIREMENTS

ASSUME 60% UTILIZATION OF CLASSROOMS
ASSUME 60% STATION UTILIZATION WHEN CLASSROOM IN USE
ASSUME 54 HOURS PER WEEK

FOR THE YEAR 1971 - 72

TERM - 1 DAYTIME

SECTION SIZE	NUMBER OF SECTIONS	AVERAGE HRS MEETING PER WEEK	TOTAL WEEKLY ROOM HRS	CUMULATIVE WEEKLY ROOM HRS	CLASSROOMS REQUIRED	CUMULATIVE CLASSROOMS REQUIRED	CUMULATIVE NUMBER OF STATIONS REQUIRED	NUMBER OF SQ. FT. STATION	TOTAL AREA REQUIRED
23	34	2.2	76	2,373	3	74.08	38.18	16.3	1,867
24	33	2.1	71	2,444	2	76.29	35.84	16.3	1,278
25	41	2.2	93	2,537	3	79.19	41.50	15.9	1,979
26	31	2.3	73	2,610	2	81.47	43.16	15.9	1,372
27	27	2.2	61	2,671	2	83.37	44.82	15.6	1,378
28	35	2.3	81	2,752	2	85.90	46.48	15.6	1,450
29	16	2.5	41	2,793	2	87.18	48.14	15.3	1,473
30	23	2.5	58	2,851	1	88.99	49.80	15.3	761
31	29	2.4	70	2,921	3	91.17	51.46	15.0	2,315
32	18	2.5	45	2,966	1	92.57	53.12	15.0	796
33	16	2.5	40	3,006	1	93.82	54.78	14.8	810
34	13	2.3	31	3,037	1	94.78	56.44	14.8	835
35	22	2.3	51	3,088	2	96.37	58.10	14.5	1,684
36	18	1.6	29	3,117	1	97.27	59.76	14.5	866
37	19	2.3	45	3,162	1	98.67	61.42	14.3	878
38	9	2.4	22	3,184	1	99.35	63.08	14.3	902
39	13	2.3	31	3,215	1	100.31	64.74	14.1	912
40	16	2.4	39	3,254	1	101.52	66.40	14.1	936
41	14	2.3	33	3,287	1	102.55	68.06	13.8	939
42	14	2.7	38	3,325	1	103.73	69.72	13.8	962
43	9	3.0	27	3,352	1	104.57	71.38	13.8	935
44	11	3.0	33	3,385	1	105.60	73.04	13.8	1,007

project grew out of the WICHE Planning and Management Systems Project.[1] In June 1968, the United States Office of Education funded a WICHE project on management information systems for higher education which included proposals to develop techniques for long-range planning and resource allocation. Representatives of 12 western states, Illinois and New York formed an Advisory Design Group which, along with the WICHE-PMS staff, surveyed the field of resource allocation in higher education. This survey included the work of H. E. Koenig at Michigan; CAP:SC developed by Peat, Marwick, Mitchell and Company; the Cost Simulation Model used at Berkeley; and CAMPUS, initially developed by R. W. Judy and J. B. Levine for the Commission on the Financing of Higher Education in Canada.[2]

The Cost Simulation Model developed at Berkeley by G. B. Weathersby[3] met the specifications[4] of the Advisory Design Group and was further evolved by the WICHE-PMS staff.[5] RRPM uses the Higher Education General Information

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[1]The WICHE-PMS Project was the forerunner of the National Center for Higher Education Management Systems at WICHE, which was formally established in April 1971.

[2]Detailed references and annotations to discussions of these models appear in: A Resource Requirements Prediction Model (RRPM-1): Guide for the Project Manager, NCHEMS Technical Report 20 (Boulder, Colorado: National Center for Higher Education Management Systems at WICHE, 1971).

[3]G. B. Weathersby, "Development and Application of a University Cost Simulation Model," unpublished monograph (Berkeley: University of California, Office of Analytical Studies, June 1967).

[4]For a detailed description of the design criteria, see: Resource Requirements Prediction Model (RRPM-1): An Introduction, NCHEMS Technical Report 19 (Boulder, Colorado: National Center for Higher Education Management Systems at WICHE, 1971), pp. 2-3.

[5]A Resource Requirements Prediction Model (RRPM-1): Report of the

Survey discipline categories and the program structure defined by the WICHE Program Classification Structure.[1] Throughout, definitions conform to those in the WICHE Data Element Dictionary.[2]

The RRPM simulates instruction and related activities and projects costs for successive time periods. It is a deterministic average cost accounting model which does not seek to optimize university operation nor relate to revenues or evaluate outputs. The model input includes enrolment forecasts, student preferences, staffing patterns, load factors, salary and cost schedules, changes in planning assumptions and instructional programs. Outputs are the resources, that is, personnel, space and dollars the institution requires to operate under the simulated conditions.

The University of Calgary is the first university in Canada to have used a model of the magnitude of RRPM (227) to simulate its own resource requirements.

Central both conceptually and operationally to RRPM is the Induced Course Load Matrix (ICLM). It is a four-dimensional weekly student hour matrix used to transform student enrolments by major and level into work loads on academic departments. These work loads form the basis for all

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Pilot Studies, NCHEMS Technical Report 21 (Boulder, Colorado: National Center for Higher Education Management Systems at WICHE, 1971).

[1] Warren W. Gulko, Program Classification Structure, 1st edition (Boulder, Colorado: National Center for Higher Education Management Systems at WICHE, 1971).

[2] Charles R. Thomas, Data Element Dictionary, 1st edition (Boulder, Colorado: National Center for Higher Education Management Systems at WICHE, 1970). These are being updated continually and are for different files, i.e. student, staff, facilities, course and finance.

instructional resource and cost computations. In order to generate the ICLM, the following data on each student for each period simulated are required: level of each course taken, discipline of each course taken, the number of weekly student hours for each course, and the faculty of registration and level.[1] Many of these data have been gathered by the Office of Institutional Research for a number of years for inclusion in the Fact Book as described in Section I, and in connection with The University of Calgary cost studies discussed in Section II.

Figures 4 through 7 show sample outputs of the model simulating The University of Calgary under a set of test conditions. The printouts illustrate model output aggregated at the university level. Outputs are also available disaggregated at the student major and academic discipline level if that degree of detail is required.

Figure 4 shows the distribution of staff and staff costs as well as supply, travel and equipment expenses which the model predicts are required to support the proposed university plan under conditions assumed in the simulation. Figure 5 gives the distribution of student contact hours by course level and instructional type, e.g., lecture, tutorial or laboratory. Figure 6 shows how the student load in Figure 5 induces a distribution of faculty contact hours. As a final example, Figure 7 illustrates the space requirements needed to carry on the simulated instruction program

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[1]The characteristics of the model are given more fully in: Bernard S. Sheehan, "Resource Requirements Prediction Model (RRPM) Developed by NCHEMS at WICHE," Reformation and Reallocation in Higher Education, ed. by Clifford T. Stewart (Claremont, California: Association for Institutional Research, 1972).

Figure 4

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NCHEMS RRPM-1.3

THE UNIVERSITY OF CALGARY
SUMMARY TEST

SUMMARY REPORT — FTE + COST — PROGRAM *.* ALL PROGRAMS

	1970-71	1971-72	YEAR A	YEAR B	YEAR C	YEAR D
ACADEMIC FACULTY FTE						
PROFESSOR	90.6	97.1	109.4	136.4	162.9	183.1
ASSOCIATE PROFESSOR	207.6	207.6	234.3	280.3	327.1	370.5
ASSISTANT PROFESSOR	221.1	224.4	248.8	304.8	360.2	412.1
INSTUC/LECTLR/OTHER	144.6	135.0	155.3	185.2	211.4	238.1
GRADUATE TEACHING AS	139.6	135.3	156.1	184.4	208.7	236.0
**** TOTAL	803.5	799.4	903.9	1,091.1	1,270.3	1,439.8
ACADEMIC FACULTY SALARIES						
PROFESSOR	$2,029,196	$2,083,601	$2,188,576	$2,609,707	$3,055,247	$3,452,763
ASSOCIATE PROFESSOR	$3,454,528	$3,430,347	$3,864,881	$4,611,243	$5,377,093	$6,090,205
ASSISTANT PROFESSOR	$2,637,410	$2,658,334	$2,955,227	$3,601,191	$4,241,089	$4,856,946
INSTUC/LECTLR/OTHER	$1,327,158	$1,239,887	$1,427,860	$1,702,390	$1,948,325	$2,198,443
GRADUATE TEACHING AS	$1,194,312	$1,159,035	$1,334,576	$1,579,778	$1,787,753	$2,024,085
**** TOTAL	$10,642,604	$10,571,204	$11,775,130	$14,104,309	$16,416,407	$18,622,442
ACADEMIC ADMIN FTE	85.0	83.9	89.5	97.9	106.4	114.6
ACADEMIC ADMIN $	$1,101,686	$1,085,623	$1,158,228	$1,273,294	$1,383,882	$1,496,113
NONACADEMIC FTE						
NONTEACH ACADS	101.0	100.2	113.6	134.3	154.4	175.2
NOT USED						
CLERICAL	1,193.9	1,182.4	1,326.5	1,556.7	1,777.7	1,998.3
MAINTENANCE	4.7	4.6	5.2	6.2	7.1	8.0
**** TOTAL	1,299.6	1,287.2	1,445.3	1,697.2	1,939.2	2,181.5
NONACADEMIC SALARIES						
NONTEACH ACADS	$1,507,251	$1,495,167	$1,689,272	$1,995,982	$2,293,172	$2,599,836
NOT USED						
CLERICAL	$6,212,875	$6,143,470	$6,897,772	$8,088,072	$9,223,779	$10,360,560
MAINTENANCE	$28,535	$28,113	$31,973	$37,043	$43,472	$49,122
**** TOTAL	$7,748,661	$7,666,750	$8,619,017	$10,121,097	$11,560,423	$13,009,518
TOTAL PERSONNEL FTE	2,188.1	2,170.5	2,438.7	2,886.2	3,315.9	3,735.9
TOTAL PERSONNEL $	$19,492,951	$19,323,577	$21,552,375	$25,499,600	$29,360,712	$33,128,073
SUPPLY EXPENSE	$8,339,591	$8,293,180	$9,195,909	$10,692,608	$12,133,927	$13,569,847
TRAVEL EXPENSE	$216,216	$236,745	$275,709	$336,724	$390,624	$428,218
EQUIPMENT EXPENSE	$2,938,594	$2,971,094	$2,971,094	$2,971,094	$3,016,750	$3,016,750
TOTAL DOLLARS	$30,987,352	$30,824,596	$33,995,087	$39,500,026	$44,902,013	$50,142,888

Figure 6

NCHEMS RRPP-1.3

THE UNIVERSITY OF CALGARY
SUMMARY TEST

SUMMARY REPORT — FACULTY LOAD — PROGRAM *.* ALL PROGRAMS

FACULTY CONTACT HOURS	1970-71	1971-72	YEAR A	YEAR B	YEAR C	YEAR D
JUNIOR						
LECTURE	1,181	1,073	1,263	1,481	1,622	1,775
TUTORIAL	362	353	414	493	541	596
LABORATORY	972	882	1,048	1,236	1,352	1,480
**** TOTAL	2,515	2,308	2,725	3,210	3,515	3,851
SENIOR						
LECTURE	2,254	2,276	2,560	3,035	3,562	4,125
TUTORIAL	225	229	266	329	395	468
LABORATORY	1,118	1,198	1,314	1,618	1,913	2,236
**** TOTAL	3,597	3,713	4,140	4,982	5,870	6,829
GRADUATE						
LECTURE	896	898	1,012	1,246	1,517	1,700
TUTORIAL	24	24	26	31	37	42
LABORATORY	362	415	528	697	870	971
**** TOTAL	1,282	1,337	1,566	1,974	2,424	2,713
SUMMARY						
LECTURE	4,331	4,247	4,835	5,762	6,701	7,600
TUTORIAL	611	616	706	853	973	1,106
LABORATORY	2,452	2,495	2,890	3,551	4,135	4,687
**** TOTAL	7,394	7,358	8,431	10,166	11,809	13,393

Figure 7

NCHEMS RRPP-1.3

THE UNIVERSITY OF CALGARY
SUMMARY TEST

SUMMARY REPORT — SPACE REQUIREMENTS — PROGRAM *.* ALL PROGRAMS

SPACE REQUIREMENTS	1970-71	1971-72	YEAR A	YEAR B	YEAR C	YEAR D
CLASSROOM	125,546	123,642	142,466	169,831	194,610	221,336
CLASS LABORATORY	198,145	192,829	220,811	261,888	295,935	332,567
RESEARCH LABORATORY						
OFFICE & CONFERENCE	317,305	314,668	353,513	418,416	480,745	541,701
LIBRARY & OTHER	137,395	135,750	155,295	184,680	214,230	243,900
NOT USED	151,525	149,286	169,781	201,486	230,848	260,848
**** TOTAL	929,910	916,175	1,041,866	1,236,301	1,416,368	1,600,352

under the test assumptions.

In summary, the use of models improves a university's data base and sharpens the administrator's definition of his informational need. Thus it improves and makes more universal, from the university department level to university system level, the parameters and their values, on which decisions throughout the entire system can be based.